June 4, 1956 50 cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Martin XP6M-1 SeaMaster

B-58 Hustler Establishes Mach 2 Powerplant Pattern

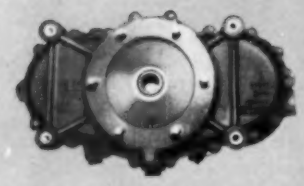
Realistic Mockup Helps Boeing Sell 707 Airliner

In aviation...
opportunity knocks twice

Now, both *military* and *commercial* aviation offer unlimited promise for an exciting, challenging and rewarding life. In both fields, Convair is today producing outstanding aircraft: *Military* aircraft like the supersonic F-102A all-weather interceptor ...faster, more comfortable *commercial* airliners like the Metropolitan 440. In the near future, the youth of America will have an even greater choice of careers through the development of atomic-powered military aircraft and vastly more advanced jet passenger planes. Aviation is the high road to opportunity for the youth of today.

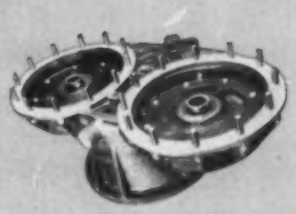
CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION



Dual accessory drive unit, rated at 40 HP at constant 3200 RPM, weight 18½ lbs.

For use on VTO aircraft, accessory drive weighs only 14 lbs. Operates on input of 35 HP at 5500 RPM. Two power take-offs operate at 7810 and 4350 RPM.



Accessory drive designed for North American, weighs 38 lbs. 70 HP input at 6000 RPM. Two power takeoffs at 6000 RPM each.

Designed and manufactured for Boeing KC97. Approximate weight 10 lbs. Six horsepower (continuous duty) input at 6000 RPM operating one power take-off drive at 2620 RPM.

Combination engine starter and accessory drive for Chance-Vought F8U-1 Navy Fighter. Ten horsepower (continuous duty) driving hydraulic pump at 4200 RPM. 55 HP intermittent service. Continuous input speed 7000 RPM. Weight 27 lbs.

Note to aircraft designers...

WESTERN GEAR

can solve your accessory drive problems!

You'll find virtually all of the nation's major aircraft manufacturers specifying Western Gear as their source of supply for components where mechanical or automatic operation is involved. Western Gear's 40 years of experience in designing and manufacturing mechanical power transmission equipment always supplies a sound, economical answer.

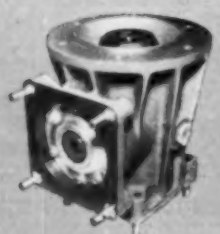
Take advantage of these years of experience to insure correct design, flawless construction and reliable operation. Western Gear engineers will be glad to help with any problem. Address General Offices, Western Gear, P.O. Box 182, Lynwood, California.

"The difference is reliability" • Since 1888

5601

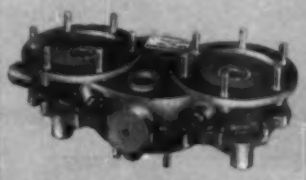
WESTERN GEAR Corporation
ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO, (CALIF.)
SEATTLE AND HOUSTON... REPRESENTATIVES IN PRINCIPAL CITIES



Dual hydraulic pump adaptor, rated at 35.7 HP at 6000 RPM, weight 26 lbs.

For Convair T-29. Approximate weight 13½ lbs. Input horsepower 103. Input speed 4000 RPM. Two power take-off drives operate at 9600 RPM each.



For use on fighter aircraft, 75 HP input at 7000 RPM. Two power take-offs, 35 HP at 3630 RPM and 37 HP at 3820 RPM. One pad for starting J-75 engine. Capable of 6600 inch-lbs. starting torque.

Production News from Bridgeport Thermostat

FROM THIS ALL-NEW PLANT— MORE AND BETTER BELLOWS

On its new 15-acre site at Milford, Conn., Bridgeport Thermostat now has 180,000 square feet of automated production facilities to assure quick delivery of all the bellows you need . . . at the lowest possible cost. A temperature and humidity controlled room for charging bellows is only one of the many ways in which this ultra-modern plant promises you bellows of consistently high quality.

¼" DIAMETER BELLOWS

Progress at Bridgeport is typified by this tiny bellows for miniaturization. Available in seamless design with a wide range of characteristics in brass, phosphor bronze, beryllium copper and monel. Larger sizes available.

Robertshaw-Fulton
CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION • MILFORD, CONN.

Please send me the following information: (Dept. LA-125)

☐ Full details on small-diameter bellows.

☐ Bellows Engineering Bulletin.

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ADDRESS_____

CITY_____ ZONE_____ STATE_____

AVIATION CALENDAR

June 5-6—Spring Assembly Radio Technical Commission for Aeronautics, Hotel Statler, Boston.

June 13—B. F. Goodrich Technical Forum, co-sponsored by Atlantic Aviation Corp. and Airwork Corp. Atlantic Aviation Hangar, Teterboro Airport, Teterboro.

June 17—Second Annual Air Show, sponsored by Post 1920 Veterans of Foreign Wars and Burlington Flying Service, Inc., Municipal Airport, Burlington, N. C.

June 17-21—American Society of Mechanical Engineers, semi-annual meeting, Hotel Statler, Cleveland, Ohio.

June 17-30—Third Annual Material Handling Training Conference, Lake Placid, N. Y.

June 18-21—National summer meeting of the Institute of Aeronautical Sciences, 7660 Beverly Blvd., Los Angeles.

June 19—Council of the International Civil Aviation Organization, 10th session, Caracas, Venezuela.

June 20-22—Aviation Distributors and Manufacturers Assn., 27th meeting, Grove Park Inn, Asheville, N. C.

June 25-27—High Temperature Symposium, Berkeley Campus, University of California.

June 28-30—Institute of Navigation's 12th annual national conference, Hotel Miramar, Santa Monica, Calif.

June 30—Jet Age Conference, Sheraton-Jefferson Hotel, St. Louis, Mo.

July 7-10—Tenth annual All-Woman Transcontinental Air Race (Powder Puff Derby), San Mateo County Airport, Calif. to Flint, Mich. Entries close June 20. For details write: Mrs. Betty M. Loufek, Loufek & London, 2611 E. Spring St., Long Beach 6, Calif.

July 8—Third annual Western New York Air Show and Races, Niagara Falls Municipal Airport, Niagara Falls, N. Y.

July 15-30—World Parachuting Championship, Moscow, Russia.

July 31-Aug. 9—23rd Annual U. S. National Soaring Competitions, Aug. 5—Air Show, Grand Prairie Airport, Grand Prairie, Texas.

Aug. 1-5—Air Force Association's 1956 National Convention and Airpower Panorama, Roosevelt Hotel, New Orleans, La.

AVIATION WEEK • JUNE 4, 1956

Vol. 64, No. 23

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Phillips 66
PRESENTS

MILESTONES IN AVIATION

Queen of the Pusher Pilots

Ruth Law, the fifth woman to hold a pilot's license, learned to fly in 1912. She soon proved she could fly as well as most men; indeed, she competed with men in the aerial contests of the time.

With her many sensational exhibitions, Ruth Law earned the right to be called America's greatest woman stunt flyer. She was the first woman on record to perform the daring aerial loop-the-loop. In one of her exhibitions of night flying, she flew around the Statue of Liberty with the word LIBERTY spelled out in lights on the lower wing of her plane.

In 1916, Ruth Law flew non-stop from Chicago to Hornell, New York—a distance of 512 miles, to establish a new world's record. She accomplished this in a pusher plane, and her flight was a truly great achievement at that time. From Hornell, she continued on to Binghamton and New York City, for a total distance of 884 miles in less than nine hours.

It's Performance that Counts!

Phillips Petroleum Company has long performed as a pioneer in petroleum research for the development of more powerful, more efficient aviation fuels. For example, Phillips was first to manufacture Di-isopropyl and HF Alkylate, two aviation fuel components of vital importance to modern high-speed, high-power performance.

Phillips produces tremendous quantities of 115/145 grade aviation gasoline for military and commercial use. And today, Phillips is also ready with improved fuels for the latest designs in turbo-props and jets.

AVIATION DIVISION
PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA

Phillips 66

AVIATION PRODUCTS

MICRO precision switches

...THEIR USE IS A PRINCIPLE OF GOOD DESIGN

Out of this design problem came a new concept in airborne switches

Not long ago, aircraft designers brought their need for a new type of switch to MICRO SWITCH. Their requirement demanded a switch of unusual versatility, capable of reliable, long-life performance under the most extreme conditions.

The result was this MICRO "EN" switch. Cylindrical in shape, it can be mounted wherever a through-hole can be provided. Variations of the "EN" are capable of actuation by almost any means. They are rugged enough to take constant pounding of drop-off cams. They are completely sealed.

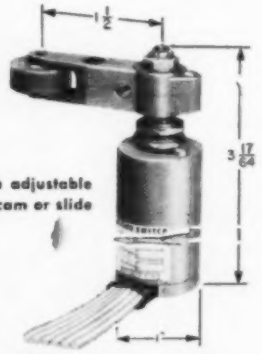
How good is this "EN" family of switches? Here's what we have found out in months of the most exacting laboratory tests:

- **Precise performance at sea level or at 100,000 feet altitude.**
- **Precise performance packed in ice at —65° F or heated to plus 180° F. (Operating force to 20 lbs. available to facilitate ice breaking.)**
- **Precise performance retained after 100 hours in salt brine spray.**
- **Precise performance after hours of immersion under 36" head of alternating icy and heated water.**
- **Precise performance unaffected by 30 days' operation at 104° F and 95% humidity.**
- **No chattering of contacts during vibration tests of from 10 to 500 cycles per second. No loosening of parts.**

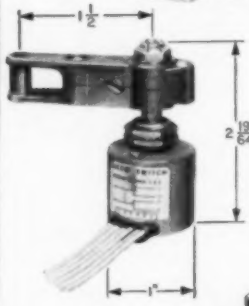
What do you want in a precision switch? If you are looking for a precision switch of the utmost reliability and long-life performance, tests like these assure that you can have it from MICRO SWITCH, a pioneer in the manufacture of precision switches.

New sealed cylindrical switches provide unusual design flexibility

Roller plunger actuator for actuation by cams and slides.



Spring return adjustable actuator for cam or slide actuation.



Positive drive adjustable actuator for linkage operation.

Plunger actuator for in-line motion operation.

MICRO SWITCH *Engineering Service is available at nearby branch offices. A call to* MICRO SWITCH *can save you time and money.*

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

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For the assignments of today, the missions of tomorrow—Vertol aircraft are trump cards in the game with the highest stakes of all—our national defense.

- The Vertol HUP series: versatile and maneuverable, this helicopter performs in a whole spectrum of naval duties: rescue, liaison, sonar dunking and towing. Hundreds are now in service with the U. S., French and Canadian Navies.
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- The Vertol H-16B: largest transport helicopter in the world, the Turbo Transporter will carry 69 troops at over 150 mph. It will revolutionize the art of logistics.
- The revolutionary aircraft now taking shape on Vertol drawing boards will blend the vertical landing and takeoff abilities of helicopters with the high speed performance of jets.

Outstanding job opportunities are available for engineers

VERTOL Aircraft Corporation

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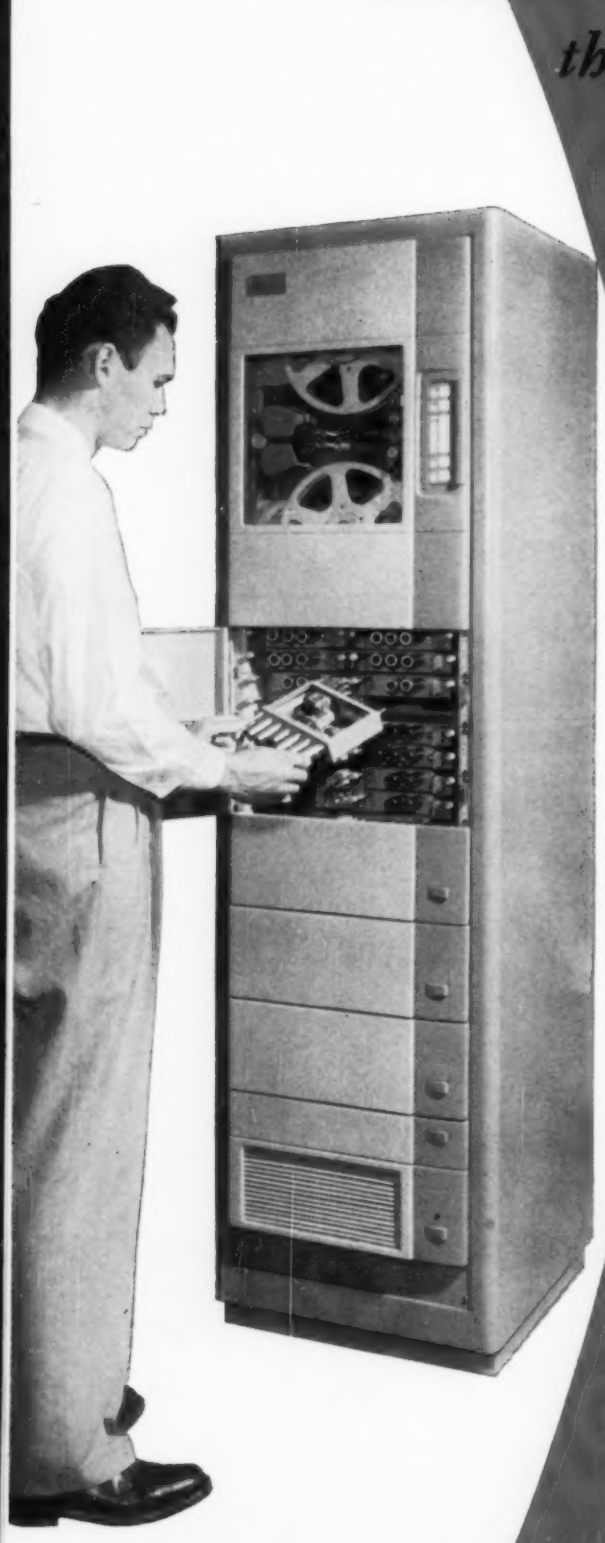
FORMERLY PIASECKI HELICOPTER CORPORATION

AMPEX PRESENTS

the most significant new data
magnetic tape



So broad in scope that it extends the far horizons of scientific and engineering curiosity

Versatility of the Ampex FR-100 permits it to serve virtually any data requirement in the entire D-C to 100,000 cycle/sec. range. Magnetic tape is inherently the most versatile of data-recording mediums and the FR-100 makes broadest use of this scope.

ANY DATA— Within its frequency range, the FR-100 can record any data that either originates in electrical form or can be transduced into electrical signals.

IN ANY COMBINATION — Any numbers of the FR-100's available tracks can be apportioned to high-frequency data, low-frequency data, transient phenomena and quasi-static measurements. Each will use tape space economically. All will share a common time base.

A CHOICE OF RECORDING METHODS — Different types of data are accommodated by plug-in interchangeable amplifiers. These permit each of the FR-100's 2 to 14 tracks to be used for direct recording, FM-carrier recording, or pulse width modulation as needed.

A SELECTION OF 6 TAPE SPEEDS — Every FR-100 tape transport provides tape speeds of 60, 30, 15, 7½, 3¾ and 1⅞ inches per second for optimum balances between recording time and frequency response. They also permit slow-down or speed-up of data in various ratios.

DATA REDUCIBLE TO ANY FORM — The FR-100's output is usable in numerous forms: visual records by oscillograph or pen recorder; visual study by oscilloscope; automatic computation by data conversion devices or computers; and regulation or activation of mechanisms by electrical controls.

THE *modular* FR-100

recorder since Ampex first pioneered for instrumentation

Performance specifications on the FR-100 are the best of any magnetic tape recorder now in production. Such accuracy adds to the FR-100's versatility. It also makes it the best choice for many well defined applications where quality of performance alone is the criteria for selection.

IMPROVED STABILITY OF TAPE MOTION — The closed loop tape drive and short unsupported tape length reduces peak-to-peak flutter to 0.1% cumulative to 100 cycles or 0.2% cumulative to 1000 cycles at 60 in/sec.

PRECISE TRACK-TO-TRACK TIMING — Record and reproduce head stacks permanently aligned with all gaps within a 1/10,000-inch band and azimuth within 0°1'. With FR-100's stable tape motion this provides lowest dynamic interchannel time-displacement error ever available commercially.

"MIL CONSTRUCTION" THROUGHOUT — Mil specification E-4158-A components, hardware and finishes are used throughout.

AMPEX-TO-AMPEX COMPATIBILITY — Recorded data is interchangeable between all Ampex FR-100s, and 300 and 800 series machines (provided tracks are the same type and tape speeds the same).

SIMPLIFIED OPERATIONAL MAINTENANCE — Modular design of the FR-100 reduces most operational maintenance to a simple plug in of spare assemblies with no loss of operating time.

The Ampex FR-100 gives your engineers and scientists a freedom to experiment. In one machine it affords a high portion of all the broadly useful capabilities of magnetic recording. It encourages development of the most effective data recording techniques for your particular specialized needs.

CAPACITY FOR BRILLIANT AFTERTHOUGHTS — The Ampex FR-100 will serve the well defined initial purposes for which it is acquired. But it also provides for the inevitable changes of direction that occur as any research, development or testing program progresses.

AN OVER-ALL ECONOMY — The combined characteristics of the Ampex FR-100 are the equivalent of dozens of different modified tape recorders built by Ampex in past years. One Ampex FR-100 may eliminate need for purchase of a succession of special machines.

For complete description and specifications on the Ampex FR-100, write Dept. UU-2750

INSTRUMENTATION DIVISION AMPEX CORPORATION

FIRST IN MAGNETIC TAPE INSTRUMENTATION

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District Offices: *Atlanta; Chicago; Dayton Montclair, New Jersey; Redwood City, California; Silver Spring, Maryland.*

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A COMPLETE FUEL SYSTEM SERVICE

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Flight Refueling, Inc. makes available to the aircraft industry a unique service and organization unusually well qualified to undertake any phase of the design, test, or on-time manufacture of aircraft fuel systems. This talent is already being used by a number of airframe manufacturers to handle complete system designs, to test fuel systems or design and fabricate fuel transfer components ranging from complete aerial refueling packages to highly efficient and intricate valves, couplings and other parts. If you have a problem in fuel flow or fuel handling let Flight Refueling, Inc. take over.

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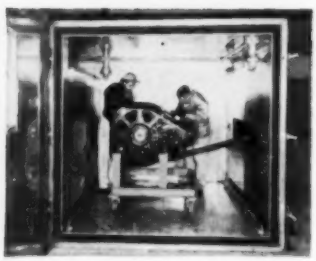
New modern plant is fully equipped for large scale production of fuel system components. Highly skilled staff prides itself on exceptional on-time delivery record.



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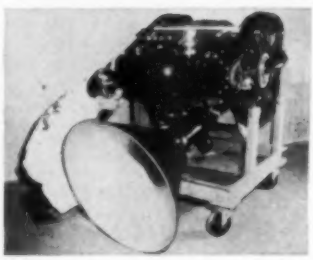
Flight Refueling, Inc. has unique fuel flow testing facilities, including a "wet lab" where in-flight conditions can be simulated at flow rates up to 1500 gpm. Full environmental test facilities, too.

FIELD SERVICE

Flight Refueling maintains an extensive, well-qualified staff of field service technicians who assure satisfactory operation of FRI-designed and manufactured equipment throughout the world.



ATTENTION **ENGINEERS**

Fascinating, new projects to develop new long-range flight systems present unusual career opportunities for engineering personnel. Write Engineering Manager for further details.

West Coast Representative: William E. Davis, Inglewood, Cal.

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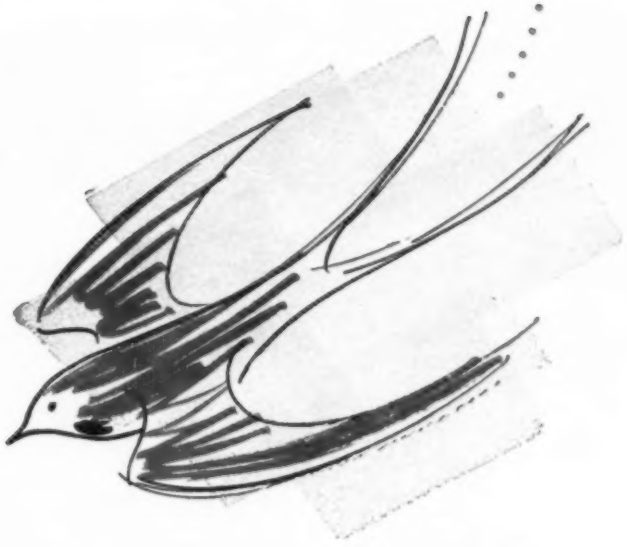
FRIENDSHIP INTERNATIONAL AIRPORT Baltimore 3, Maryland

Dayton: Robert L. Marquardt, Dayton 9, Ohio

follow the swallow

FLY LIGHT



ARC's new ADF weighs less than 20 lbs!

TYPE 21 ADF WEIGHS ONLY 19.7 POUNDS

Component Units Weights: Receiver, 6.8 lbs.; Loop, 4.3 lbs.; Loop Housing, 0.5 lbs.; Control Unit, 1.6 lbs.; Indicator, 1.3 lbs.; Power Unit, 5.2 lbs.
CAA Type Certificated

Birds have nature's navigation instruments and can return unerringly to their nests from a continent away. They follow special flyways as you follow a chosen course.

But you can out-navigate the birds with ARC's miniaturized ADF. Here, after two years of testing, is an Automatic Direction Finder of great reliability—in a system whose combined parts weigh less than 20 pounds. It requires less power, too—only 2.8 amps at 27.5 volts. It has hermetic sealing of vital parts, including the entire loop, and other mechanical design features to insure ARC-dependability under today's exacting requirements. Now a dual installation, where required, will save 80 or more pounds and make room for other much-needed equipment or more payload.

The ADF is still the Number One worldwide navigational aid, usable on an estimated 60,000 radio stations. ARC's Type 21 is tunable to all frequencies from 190 kc to 1750 kc.

An outstanding feature is extremely low drag of the loop housing, which extends only two inches into the airstream.

Here is reliability you can trust—in a small package ... high performance to ARC standards, trusted for 28 years. Ask your dealer for descriptive literature.

Omni/ILS Receivers • Course Directors • UHF and VHF Receivers and Transmitters
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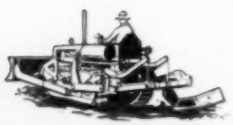
NEW RESEARCH and ENGINEERING CENTER

Offers Diverse Engineering Opportunities in Commercial and Military Hydraulics

Phenomenal and continuing expansion in the use of oil hydraulics by an ever-increasing number of industries brought the need for this new Vickers 150,000 square foot building (in suburban Detroit) devoted primarily to research and engineering.

Here is an abundance of opportunity for engineers at all levels to grow in professional stature and income. The range of opportunity is as wide as industry itself, because Vickers is a major supplier of hydraulic components in all the fields illustrated below. The continuity and stability of opportunity are assured by the increasing growth rate of hydraulic applications . . . both industrial and military.

Vickers is going places . . . go places with Vickers.

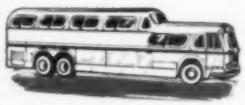

Farm and Industrial Tractors

Commercial Aircraft

Military Aircraft

Automation for Industry

Automobiles


Buses

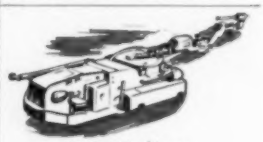
Earth Moving Equipment

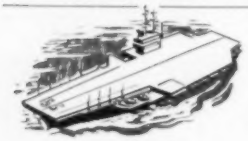
Agricultural Machinery

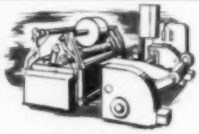
Commercial Vessels

Materials Handling Equipment

Atomic Weapons

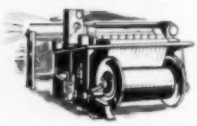

Mining Machinery


Naval Vessels


Paper Machinery

Plastic Molding Machines

Metal Presses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Trucks (all sizes)

Typical applications of Vickers Hydraulics . . . components and complete systems with electronic or mechanical control . . . are shown above. Vickers has been supplying these (and many more) for a number of years . . . is not a newcomer in the field of hydraulics. Obviously, this extreme versatility offers challenging opportunities for engineers with a wide variety of talents and interests. For further information, get in touch with Mr. R. E. Barlow. Phone him at Liberty 9-1122 or write him at:

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Division of Sperry Rand Corporation

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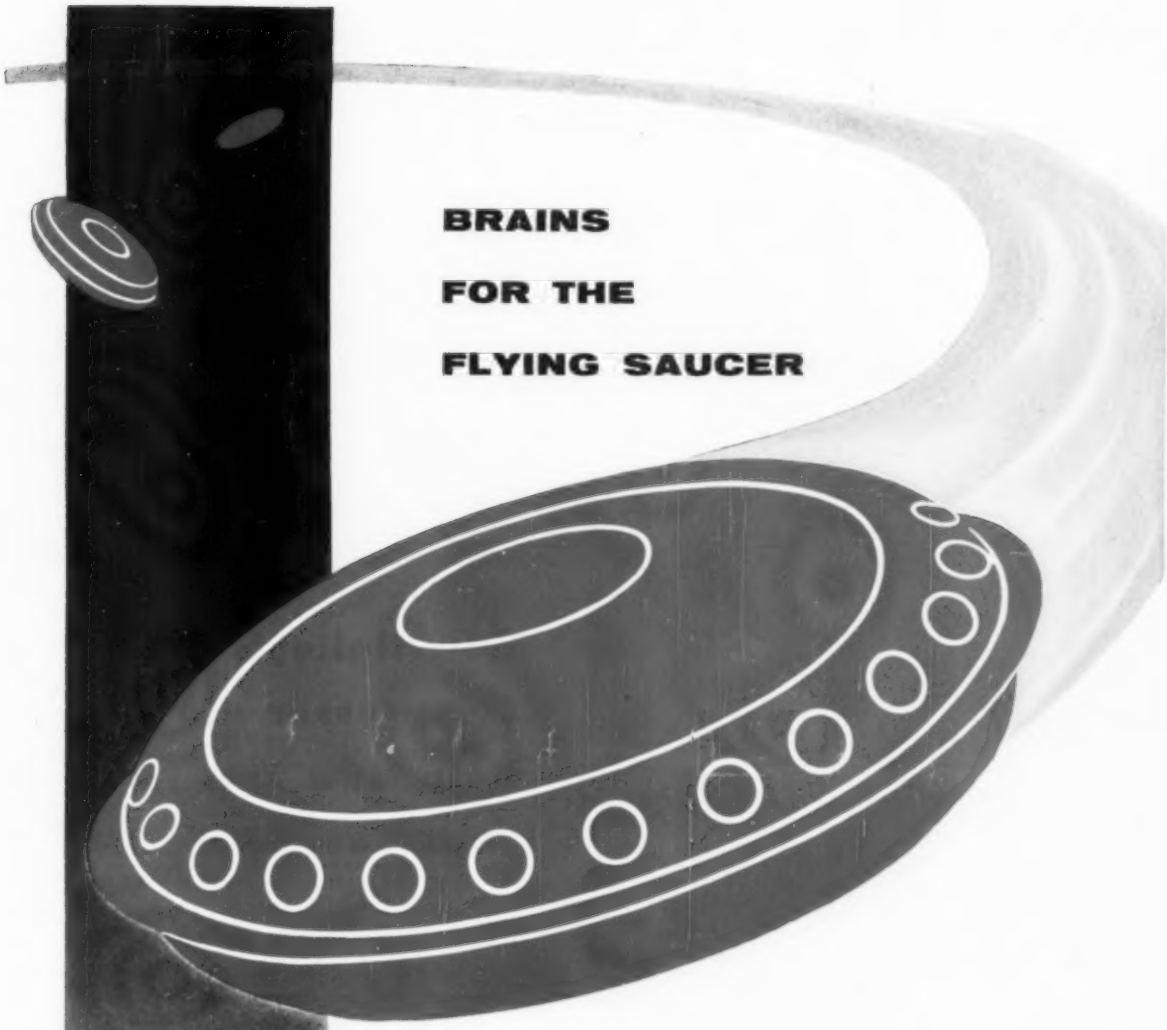
Engineers and Builders of Oil Hydraulic Equipment Since 1921



BRAINS FOR THE FLYING SAUCER

. . . when flying saucers ride the air!

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AC is ready. In the research and engineering laboratories of AC, control systems are now in development which are easily capable of handling any of the special guidance or navigational problems that a flying saucer would be likely to pose.

It is that ability to stay a step ahead which has built AC's reputation as one of America's foremost sources in the fields of electro-mechanical research, development and production.

Guided missile . . . or flying saucer. AC is ready now!

THE AC ELECTRONICS DIVISION OF GENERAL MOTORS

Flint, Michigan • Milwaukee, Wisconsin

How Holley's Compressor Governors Help New Jets to Supersonic Speeds

"City-savers" Air Force men call them: the J-57-powered F-100, F-101, F-102 and Navy F8U, with level flight speeds faster than sound. And city-savers they could well be. Certainly their rapid approach to the fringe of Mach 2 heralds a new era in the progress of jet flight.

Sharing in the development of this new brood of supersonic fighters, Holley engineers, working closely with Pratt & Whitney Aircraft on the J-57 engine, designed the compressor bleed governor.

This new Holley compressor bleed governor is one more example of Holley's continuing leadership in the design, development and manufacture of superior engine control systems for both military and civilian use.

Leader in the design, development, and manufacture of aviation fuel metering devices.

HOLLEY Carburetor Co.

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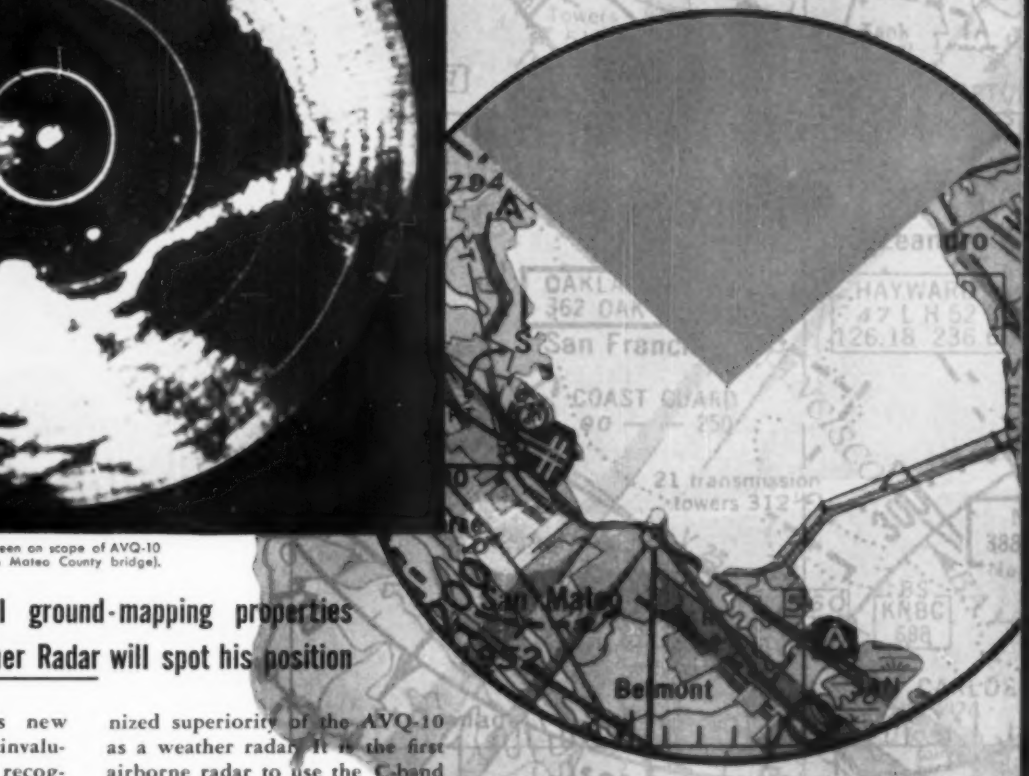
A-24

WHEN A PILOT NEEDS A LANDMARK...

Circled portion of aeronautical chart as seen on scope of AVQ-10 on in-bound airliner (Note Hayward-San Mateo County bridge).



Portion of sectional aeronautical chart looking north on San Francisco Bay area.

the exceptional ground-mapping properties of RCA's Weather Radar will spot his position

Air carriers find RCA's new Weather Radar (AVQ-10) invaluable in making landfalls and recognizing landmarks under adverse weather conditions in areas where navigation aids are comparatively inadequate.

The AVQ-10 provides a crosscheck on normal navigation methods, enabling the pilot and navigator to determine their position with great exactness relative to the coast line. This is equally true on inland routes where topographical features show up clearly on the scope. The AVQ-10 also helps to locate the proper entry point in defense areas, where aircraft are limited to "corridors."

These ground-mapping characteristics are in addition to the recognized superiority of the AVQ-10 as a weather radar. It is the first airborne radar to use the C-band (5.6 cm) transmission, the wavelength best suited to weather detection and avoidance, yet having the least amount of scope clutter. With it, the pilot can evaluate storms up to 150 miles ahead and pick non-turbulent paths between them. In addition to avoiding costly detours, the AVQ-10 contributes materially to passenger comfort.

All this has made the demand for the AVQ-10 great and pressing. Many leading airlines have already specified it. To secure early installation, other airline and executive plane operators are invited to write now for further information.

CUSTOM AVIATION EQUIPMENT

RADIO CORPORATION of AMERICA

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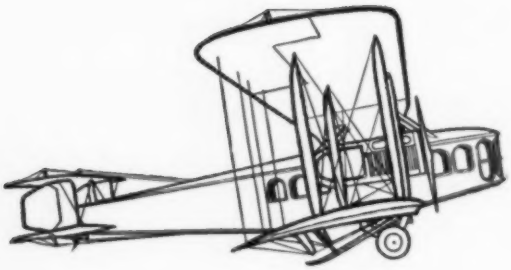
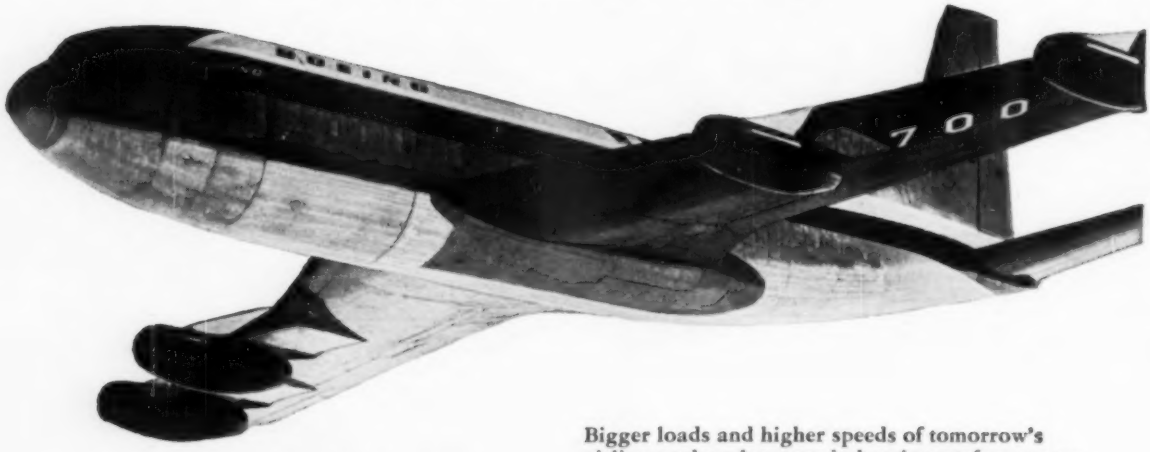


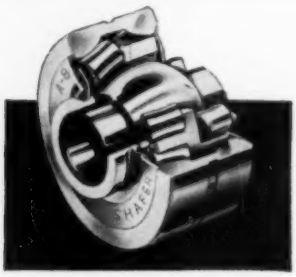
This Lawson airliner began service from Milwaukee to New York and Washington and return in 1920. It carried 20 passengers at an average speed of 110 m.p.h.

IN COMMERCIAL AIRLINERS...

it takes a lot more today



Today's new Boeing Jet Stratoliner will carry 130 passengers at speeds in the 555 m.p.h. range, making five-hour commercial coast-to-coast operations common.



Double row shown. Also, single row bearing, rod end and torque tube bearings. Design features 10° plus or minus self-alignment...easy relubrication without disassembly... exceptional shock-load reserve strength.

Bigger loads and higher speeds of tomorrow's airliners take a lot more in bearing performance—and Shafer Aircraft Bearings are providing it.

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2) Full capacity—*under combined loads.* Double row bearings carry any radial-thrust combinations on full contact area under any misalignment.

3) Relubrication—*without disassembly.* Lubricating groove allows burying Shafer in any member provided with lubricating fitting.

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SHAFER BEARING DIVISION

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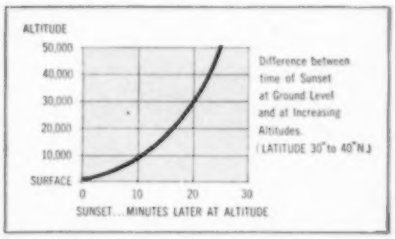
FLY WEATHER-WISE

These weather items prepared in consultation with the United States Weather Bureau

NIGHT FLYING

ON NIGHT FLIGHTS you may have to fly on instruments in haze or smoke condition, due to loss of horizon. It's also hard to judge distance from clouds, and you may find yourself in them. Keep in mind that fog is more common at night than in daytime. And on clear nights over desert areas near mountain ranges, strong Katabatic winds (cool air sliding down mountain slopes) can reach gale strength. This can make it difficult to hold altitude with available power.

However, as a rule, air becomes smoother after sunset, as vertical currents tend to subside. This is especially true in lower levels.



Remember — when it's twilight at 6000 ft. it is already dark on the ground, due to curvature of the earth. Graph above illustrates this. To land before dark, determine sunset time and plan flight accordingly.

Watch ground lights at night for signs of fog. This is indicated by lights appearing fuzzy or indistinct.

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JUNE 4, 1956

AVIATION WEEK

VOL. 64, NO. 23

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Mary Whitney Fenton, Elinore Eisenson, Joan Read

Nike Scores Well in Test 26
▶ Army's Nike scores seven out of eight hits in test put on during service row. Only miss a malfunction.

ATA's Tipton Criticizes CAB Fare Probe 32
▶ Stuart G. Tipton, president of Air Transport Association, says CAB investigating fares for wrong reason.

Pan American Begins New Era 40
▶ Pan American World Airways starts first regularly scheduled nonstop New York-Paris service with DC-7C.

B-58 Sets Pattern for Mach 2 Powerplant 50
▶ The pattern for one type of powerplant in the next generation of Mach 2 aircraft has been set by Convair's B-58 Hustler.

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EDITORIAL

The New NATO-Shield or Diaphragm? ...21

COVER: Flight tests of XP6M-1 Martin SeaMaster are termed unusually promising by Navy. The 600-mph. multi-jet seaplane has been undergoing tests from Chesapeake Bay near Baltimore. Note in picture spread on pages 58 and 59 rotary door for minelaying forward, hydroflaps rear, wing-top jet engine nacelles and tall T-shaped tail. Flaps on both sides of rear hull can be used individually as rudders or as brake when opened together.

Picture Credits:
67—Sovfoto.

63,926 copies of this issue printed

AVIATION WEEK • JUNE 4, 1956 • Vol. 64, No. 23
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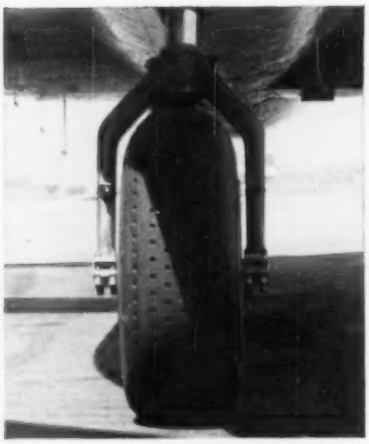
B.F.Goodrich

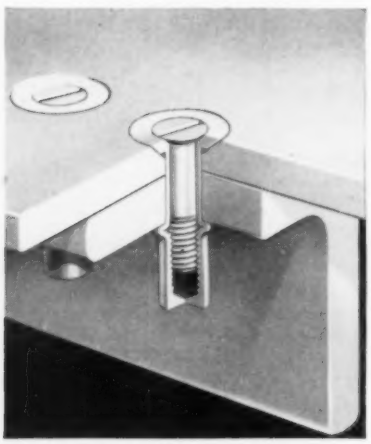
offers six ways to trim weight, reduce costs, improve maintenance



Tubeless to save weight, dimpled for more landings—B. F. Goodrich Tubeless Tires mean greater payloads—120 pounds for one airline. Save time and money in warehousing by eliminating the tube. The BFG Dimpled tread wears slower, more evenly, gives more landings before recapping.

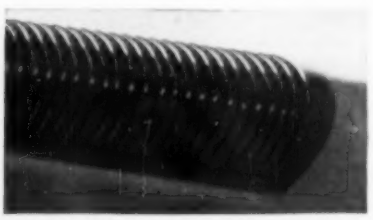
Lands big ones safely—BFG wheels, load-rated 60,000 lbs., give maximum strength with minimum weight on Boeing's B-47. What's more, this wheel stood up under test loads of 300,000 lbs.! B-47's dual wheel assemblies are equipped with B. F. Goodrich brakes.

B. F. Goodrich brakes stop Northwest's new 1049-Gs smoothly, give long maintenance with more even wear. When fluid pressure is introduced, a full circle "tube" lifts each brake block evenly around the full circle of the drum. The entire braking surface is utilized.



BFG Rivnuts give Tiger a longer leap
Grumman engineers form integral wing tanks of F11F-1 Tiger with top and bottom aluminum wing sections fastened together by new B. F. Goodrich Seal-Head Rivnuts—only one-piece blind fastener with threads. Fuel-tight Rivnut is approved for primary structures.

Heated girdle gives life-saving hug
B. F. Goodrich electrically heated rubber is one of the most efficient ways of applying spot heat. It's light, flexible, has many applications. Here it fits snugly over oil valve to maintain vital flow of lubricating oil despite low temperatures.



B. F. Goodrich de-icers break the ice faster—Chordwise pneumatic De-Icers on Lockheed Super Connies have smaller tubes, electronic controls, quick-snap inflation cycles. For more information on these and other products, write: *Aeronautical Sales, B. F. Goodrich Tire and Equipment Company, a Division of The B. F. Goodrich Company, Akron, Ohio.*

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EDITORIAL

The New NATO-Shield or Diaphragm?

The North Atlantic Treaty Organization is facing new and important problems that are closely related to the great debate now in progress over the future size and technical development of American airpower.

Recently we listened to an extremely frank and lucid discussion of these new NATO problems by Gen. Lauris Norstad, new Supreme Allied Powers Commander, and Lord Ismay, secretary-general of NATO in their Palais de Chaillot headquarters in Paris. From this briefing we gathered the following impressions:

• **First**—NATO is still very much necessary. It would be the sheerest folly to lower the guard in Western Europe solely on the basis of the new Soviet policies. Perhaps the best testimony as to NATO's importance comes from the energy the Soviets are devoting to their campaign to dissolve it.

• **Second**—NATO still has essentially the same strategic function of providing a dam against further Soviet advances westward but its military tactics to accomplish this goal have changed radically during the past two years. The old NATO tactics called for a heavily armored shield of ground forces utilizing air support to repel any enemy attack as close to the western borders as possible.

Main Reliance Atomic

Now, the main reliance has shifted to atomic firepower delivered by aircraft and missiles. The role of ground forces has shifted from that of a shield to that of a sensitive diaphragm that will record the first enemy attempts at armed aggression. Rupturing of this relatively thin line of NATO ground forces by an enemy would release the trigger firing all of the combined atomic firepower of the NATO powers in the same manner that the rupture of the diaphragm in a research gas gun triggers the generation of hypersonic flow forces.

Although any serious aggression would begin by aerial assault it is still important to maintain this sensitive diaphragm of ground troops because it is tangible evidence of where the frontier has been drawn and it makes necessary use of military force by an enemy bent on further aggression. Without the ground troops it would be easy for an enemy to penetrate further westward in small steps, upsetting local governments and providing "police assistance" to restore order.

General Norstad made it crystal clear that NATO will respond to any enemy aggression with atomic weapons. These include not only the aircraft and missile delivery systems now based along an arc stretching from Norway to Turkey but also the strategic bombing force of the Royal Air Force in England, USAF's Strategic Air Force based around the world and the long-range striking force available from USAF's Tactical Air Command using aerial refueling of atomic weapon carrying fighters. It was made very clear that rupturing of the NATO diaphragm will trigger not only NATO forces in Europe but all of the airpower of NATO countries wherever it is based. At the moment this is a retaliation force no nation would care to stimulate. At the present it has the capability of absorbing the most powerful attack that any potential enemy could mount against it and still return a pulverizing counter-blow.

Other Military Task

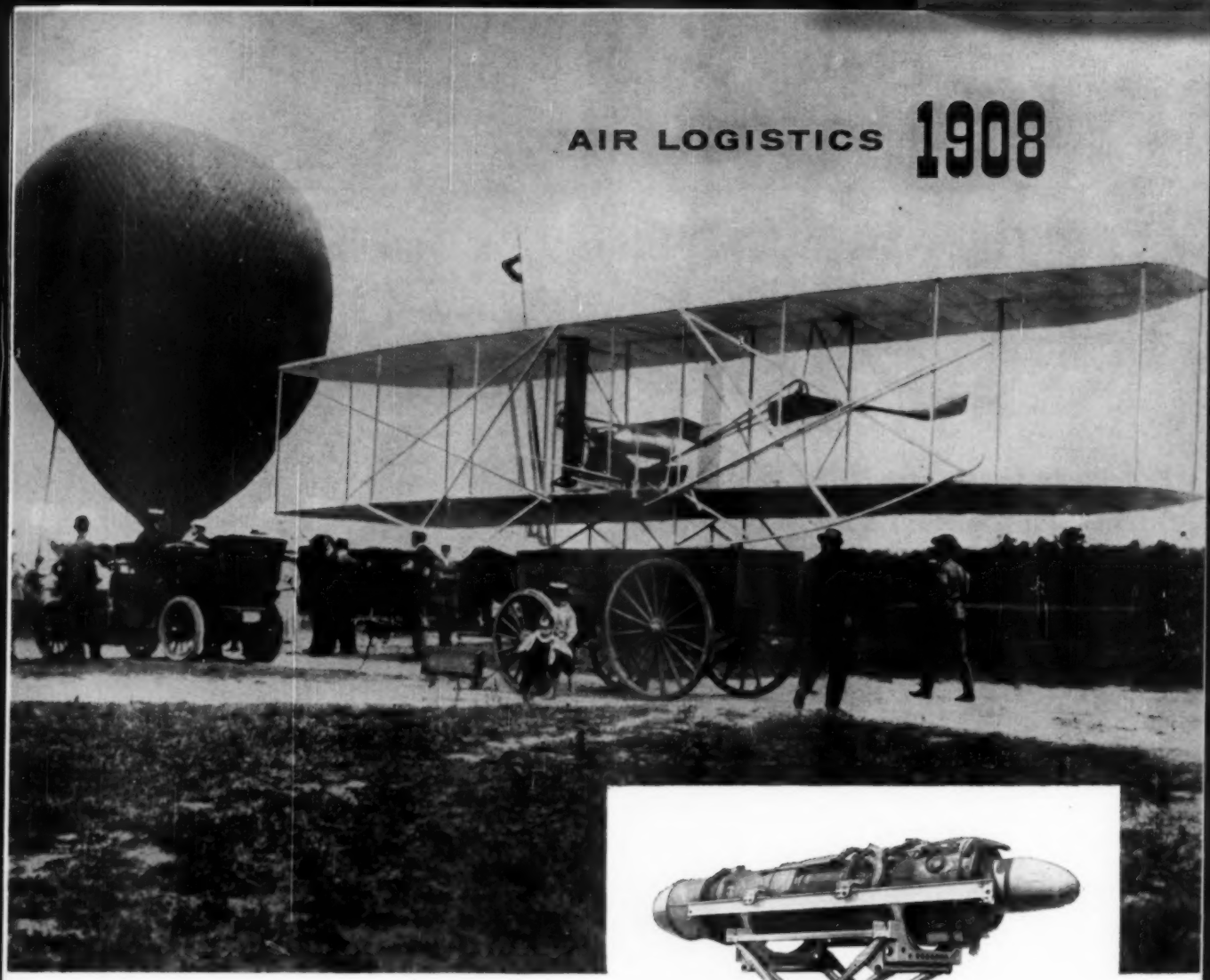
NATO's other current military task is to make the launching of a successful surprise air attack against its retaliatory forces. Toward this end NATO has built a new complex of airfields supported by modern logistics, including a fuel pipeline network and air supply. This complex has been built as far behind the radar warning net as possible and it has grown from less than a dozen usable military fields to more than 300 modern airbases supported by another 300 commercial or auxiliary fields. Further target dispersion is provided by the carrier forces of the Sixth Fleet in the Mediterranean, the Royal Air Force in England and the far-flung bases of SAC.

It is this task of creating a retaliatory force large and fast enough and sufficiently dispersed to make it impossible for any enemy to blunt its devastating force by a surprise attack. The bigger the retaliatory force and the more it is dispersed the tougher the problem of wiping it out becomes. This is why the western world needs the Royal Air Force bombers and missiles; the supersonic water-based bombers of the Navy, carrier-based atomic bombers and the long-legged atomic weapon carrying fighters of TAC. Unless an enemy can count on knocking them all out of action in a few hours he will hardly risk the fission and fusion deserts they will create in his country.

This is what is so chilling about Defense Secretary Charles Wilson's statements that we do not intend to keep up with Russia in long-range bomber production; in White House assurances that intermediate-range ballistic missiles are not really significant; in the conclusions of the House Appropriations Armed Services Subcommittee that the Eisenhower Administration has given up the traditional American policy of maintaining air superiority and is settling for a second best airpower "just big enough" to keep a possible enemy wary.

Unless U. S. policy is fixed firmly to the concept of maintaining superior airpower in developing new aerial weapons faster than any potential enemy the entire defense effort beginning with NATO will collapse like a house of cards.

—Robert Hotz



...“the flying machine must be designed to be carried in an Army wagon.”

U. S. Army specifications, 1908

Aircraft ground support equipment has come a long way in 48 years. The *Air·Log System* – one unit of which, the Model 4000A positioning trailer, is shown in inset – is an example of system engineering required to meet the exacting demands of the Armed Services to maintain *Readiness* in this jet age. The research, engineering, and manufacturing facilities of Air Logistics are dedicated to furthering that *readiness* by designing and producing a complete *system* of ground support equipment today that will meet tomorrow's demands of both military and civilian aviation.

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Bert M. Harsh, vice president, Hawthorne Flying Service, Moultrie, Ga. Also: **John M. Hawkins** (vice president), resident manager of Charleston headquarters and fixed-base operations.

Honors and Elections

Walter T. Bonney, assistant to the executive secretary of the National Advisory Committee for Aeronautics, has received the first public relations award of the Aviation Writers Association for his contribution towards a "better public understanding of research problems through intelligent and simplified dissemination of highly technical information."

Changes

Arthur T. Curren, commercial sales manager, and **A. Elliott Merrill**, military sales manager, Boeing Airplane Co., Seattle, Wash. Also: **D. B. "Ted" Martin**, sales director, Seattle Division; **Kenneth C. Gordon**, special transport division sales; **Hans Ott**, transport division sales, (Geneva, Switz.), and **Robert J. Murphy**, assistant to director of sales.

George E. Pelletier, public relations director, Aerojet-General Corp., Azusa, Calif. He succeeds **William H. Taft**, who is now producing a series of public service documentary films, by Aerojet for the Defense Department.

Arnold E. Hayes, general manager-secretary, Clifton Precision Products Co., Inc., Clifton Heights, Pa.

Candido Llovera, U. S. operations manager (Idlewild Airport), Iberia Air Lines of Spain.

George Mangurian, chief analytical engineer, Northrop Aircraft, Inc., Hawthorne, Calif. Also: **Roy P. Jackson**, assistant chief engineer; **Don D. Warner**, chief-structures, and **Jack Mannion**, assistant to vice president and general manager.

George L. Bright, sales training director, Mohawk Airlines.

INDUSTRY OBSERVER

► **Most powerful ground radar ever built in the U. S. will undergo Air Force tests at Laredo, Tex., possibly to evaluate its ability to detect and track ballistic missiles fired at the White Sands, N. M. Proving Ground 500 mi. away. Another possibility is that the multi-megawatt radar, mounted atop a 100 ft. tower is being evaluated for its ability to detect surfaced submarines in the Gulf of Mexico to make in effect a southern DEW line.**

► North American Aviation, Inc., has flown 25 test vehicles of its SM-64 Navaho intercontinental missile. Twenty of the vehicles, all of them equipped with landing gear, were recovered.

► **Flap structures on the Boeing B-52 have been strengthened to withstand sonic vibrations from the eight Pratt & Whitney J57 turbojet engines using water injection. In some instances, the vibration had caused skin cracks to develop in the structure.**

► Parts for the first Crossbow subsonic air-to-ground missile are now being assembled by Radioplane, Inc. The vehicle should be test flown within the next month.

► **Air Force hopes to tow an airborne target through Mach 1 by early summer. Tests up to Mach .9 have been made thus far.**

► A rocket sled track being built at USAF's Armament Center, Eglin AFB, Fla., is designed to provide velocities up to Mach 3 for evaluation of weapons effectiveness. Controlled impact can be obtained at velocities simulating the speed of an aircraft plus the speed of the weapon, without the weapon being fired.

► **Experiments are underway on frangible versions of the Beech Dart towed target (AW May 7, p. 53) that disintegrate when hit by gunfire, giving pilots the feel of a "kill." New models are made of paper honeycomb, plastics and other light materials. Standard Darts are made of plywood and steel tubing.**

► Army is equipping a number of Beech L-23 Twin-Bonanzas with radar reflectors to allow calibration of low-level accuracy of Nike missile units' radar coverage.

► **Lockheed's Mach 2 F-104A Starfighter is equipped with an air conditioning system, pneumatic starter and fuel control designed and manufactured by Hamilton Standard Division of United Aircraft Corp.**

► Roll out of Canadair's CL-28, maritime reconnaissance version of the Bristol Britannia turboprop transport, is scheduled for sometime towards the end of the year. A total of 25 of the aircraft have been ordered thus far.

► **Approximately 600 lbs. of fiberglass will be used in the Boeing 707 jet transport between the inner and outer fuselage shells to deaden sound caused by high-speed air friction. Vibration dampers will be used where the inner shell is connected to the fuselage frames.**

► U. S. Army is studying Navy's shipboard mirror landing system for possible application on relatively-short, forward-area landing strips. The idea originally was borrowed from the British Navy.

► **The cost of Jato take-off units for the B-47 bomber have been reduced from about $450 to $160 per unit. A fully-fueled, combat loaded B-47 requires about 30 units—costing a total $4,800—for a takeoff.**

► Douglas Aircraft reportedly has had to lower its DC-8 guaranteed maximum Mach number at high altitudes because of gust load safety factor requirements. The Douglas jet transport wing uses three different Douglas-developed airfoil sections.

Model 4-D, 4 cfm., 3000 psi., 11 lbs. without motor, 10" envelope

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WASHINGTON ROUNDUP

Symington Widens Probe

The Senate Air Power Investigating Subcommittee headed by Sen. Stuart Symington (D.-Mo.) will extend its investigation into all phases of Army Aviation as well as the Army guided missiles programs.

The subcommittee already has taken executive testimony from Maj. Gen. H. H. Howze, director of Army aviation; Lt. Gen. James Gavin, chief of research and development, and Maj. Gen. E. G. Wheeler, director of plans.

Thus far, the subcommittee's open "hearings" have amounted to no more than the reading of prepared questions by the subcommittee's counsel, Fowler Hamilton, and the reading back of prepared answers by the witness. No extemporaneous questions are asked by senators and no extemporaneous remarks made by witnesses.

The subcommittee is expected to drop this controlled procedure when the Civil Defense Department heads—including Secretary of Defense Charles Wilson—appear in wind-up sessions. By then, Symington and Democratic Sen. Henry Jackson of Washington, who have been sharply critical of Defense Department policies, will have a complete record of technical testimony on which to base their questioning.

There has been only one public clash between Democratic and Republican members up to now. Republican Senators Leverett Saltonstall (Mass.) and James Duff (Pa.) submitted written questions they wanted answered directly to Lt. Gen. Earle Partridge, commander of the Continental Air Defense Command. Symington criticized the procedure at an open session and directed that all future questions be submitted to witnesses through Subcommittee Counsel Hamilton.

New Civil Air Study

Airport and air navigation problems facing civil aviation with the large-scale introduction of jet transports will be the main concern of the study being launched by a House Government Operations Subcommittee headed by Rep. Robert Mollohan (D.-W. Va.). Hearings are expected to open in about a week. Key witnesses will be William Barklay Harding, New York financier; Edward P. Curtis, special aviation assistant to the President, and Adm. C. E. Rosendahl. Harding headed a seven-member group under the Bureau of the Budget which recommended the preparation of a 20-year plan for aviation facilities early this year (AW Jan. 16, p. 26). Rosendahl heads the National Air Transport Coordinating Committee formed to deal with air-traffic problems in the New York area following several serious crashes in 1952.

Other Democratic members of the subcommittee are: John Blatnik (Minn.); Joe Kilgore (Tex.); Martha Griffiths (Mich.); Earl Chudoff (Pa.). Republican members are: George Meader (Mich.); J. Arthur Younger (Calif.), and William Minshall (Ohio).

Segregation and Airport Funds

The airport construction program faces increasing opposition from southern members of Congress because of the Civil Aeronautics Administration's position that federal funds cannot be granted for facilities at which racial segregation is practiced.

The issue was the basis for the opposition by Sen. Thomas Wofford (D.-S. C.) of confirmation of Charles J. Lowen as Civil Aeronautics Administration Administrator. In a minority report, Wofford pointed out that Lowen, as acting administrator, instructed the regional CAA director at Fort Worth "to secure an assurance from the officials at Hawkins Field, Jackson, Miss., or to exclude public facilities at the field from federal-aid participation if racial segregation was to be practiced in the facilities." Lowen issued the memorandum "affecting a very serious matter," Wofford declared, "without legal basis."

He said Lowen "exceeded any authority granted or implied by the Congress, and, in fact, the Congress has refused to impose such penalties, as in, for instance, the federal-aid-to-schools bill."

Despite the southern opposition, Lowen's confirmation by the Senate appears assured.

Minetti Confirmed

Senate confirmation of G. Joseph Minetti as a Civil Aeronautics Board member will give the Board five members for the first time in over five months. Minetti will fill the Democratic vacancy held by Josh Lee, whose term expired Dec. 31.

ALPA Urges Independent CAA

The Air Line Pilot's Association last week charged that aviation requirements have been "badly neglected" by the Department of Commerce and that air space problems have reached "almost national emergency proportions."

Testifying before the Senate Aviation Subcommittee headed by Sen. A. S. Mike Monroney (D.-Okla.), ALPA President Clarence Sayen urged Congress to divorce the Civil Aeronautics Administration from Commerce Department control and give it independent status. Sayen said the Commerce Department has "failed to grasp the full significance of the problems confronting aviation" and that, because of past inaction, a "major national program" is needed.

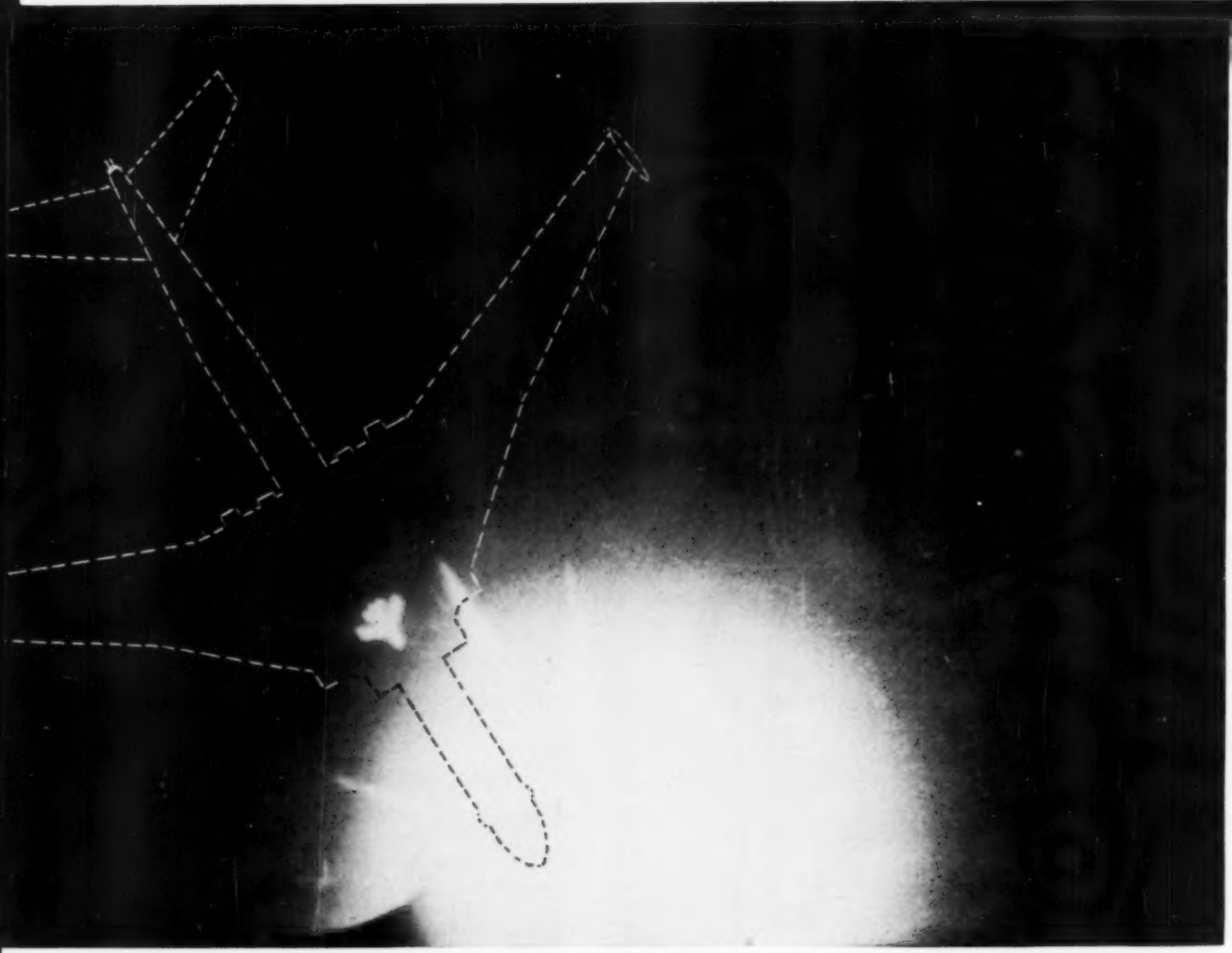
White House Bilateral Powers Hit

A bill designed to curtail White House powers in international route cases and give the airlines a greater part in bilateral air negotiations has been filed in the Senate by Senators Monroney and George Smathers (D.-Fla.). The bill formalizes recommendations made by the Senate Interstate and Foreign Commerce Committee in its unanimously approved report on international air agreements.

The proposed amendments to the Civil Aeronautics Act would take away the President's power to rule on air routes to U. S. overseas territories and within U. S. territories and possessions. Presidential approval of international route cases would be limited to issues of national defense and foreign policy.

The bill also specified that the CAB should consult with affected airlines before and during bilateral air negotiations with foreign countries and that an airline representative should be made a full member of any U. S. delegation to bilateral negotiations. The airline member would attend all meetings and have a chance to consult with the carriers before a final decision could be reached.

—Washington staff



RUSSIAN Bison long-range bomber, superimposed on picture of Firebee drone taken at instant of Nike warhead detonation shows relative sizes compared to lethal radius of burst. Sizes also help explain why a tiny drone might escape destruction by fragments that would kill a large bomber. Photo was taken from Askania photo-theodolite tracking instrument. Firebee was above 16,000 ft. and making 500 kts. when the intercept occurred.

Army's Nike Scores Seven for Eight

One miss a malfunction causing fail-safe air burst over launching site. Test made during service row.

By David A. Anderton

White Sands Proving Ground, N. M.—A final scoring of eight Nike rounds fired here during a two-day press tour gave the Army's anti-aircraft missile seven successive strikes for eight birds launched. There was a single missile malfunction that caused a fail-safe air burst above the launching site.

The Army scoring system for rating Nike batteries does not count the malfunction against the firing battery. This procedure gave a widely reported impression that the Army claim was for 100% hits.

Timing of the Proving Ground tour coincides with the Army-Air Force row over the relative capabilities of the Nike and Talos, a Navy-developed shipboard anti-aircraft missile which USAF wants for defense of SAC bases in the United States. The timing made it look as if Army were firing the rounds to refute USAF claims of Nike inferiority.

Not Comparable

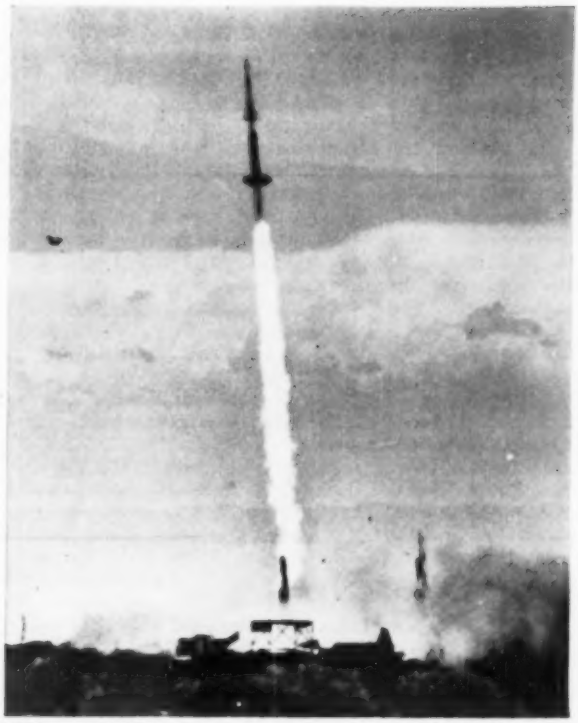
But Nike and Talos are not directly comparable, and "comparative" tests would not prove anything. Nike is the older weapon and has been operational since December 1953. Talos is still in the development-firing stage although it is in production under a Bendix prime contract. Nike was planned as an inner zone defense to take over after long-range interceptor and missile attacks had whittled down the aggressor air strike.

There is no argument on the limited range of Nike. Longest intercept by the missile was at a slant range of just under 26 mi., about at the point where a bomber with B-52 performance would be releasing its bombs. Talos range is about twice that of Nike.

Firing at Targets

Six of the rounds were fired against Radioplane OQ-19 target drones at altitudes under 18,000 ft. above the local terrain and speeds of about 180 mph. The other two, fired as part of an Army program to determine Nike capability against a small jet-propelled target drone, were launched against the Ryan OQ-2 Firebee traveling at 500 kts. at about 16,000 ft. above terrain.

This octet of firings plus other data on the overall scores obtained during the annual practice firings at Red Canyon indicate the Nike is highly reliable as an operational weapon. Most USAF squadron commanders would be delighted with a 95% availability of combat aircraft at all times; that figure



NIKE round fired during press tour of White Sands Proving Ground roars up to intercept jet-propelled Firebee drone.

ARMY BIG THREE: Honest John, Nike and Corporal missiles shown on their field service launching units.

being approached closely by the Nike missile.

The significance of that percentage takes on greater value considering the age of the Nike rounds fired during practice. The standard procedure is to take the Nikes that have been in on-site storage longest to Red Canyon. Some of the birds fired there are as much as three years old. This is comparable to taking a fighter out of three-year storage and finding it to be ready to fight with all the avionic gear working, all systems operating and the guns able to fire.

Warhead Effects

Nike's warhead is a fragmentation type, detonated at a computed location in space by an automatic signal from the ground link. Location of the burst is calculated to produce maximum lethal effect. Generally it is below and ahead of the target. The detonation of the warhead spreads out a huge area of fragments over the sky and the target flies on a collision course into the spread.

Such a warhead blast does not need to destroy a target drone in order to rate as a successful strike. The distance between individual fragments is large enough to let a drone slip by unscathed sometimes. But a full-scale airplane, many times the drone's dimensions, could be shredded by the shrapnel. The slip stream would do the rest, levering off the panel skin punctured by the fragments.

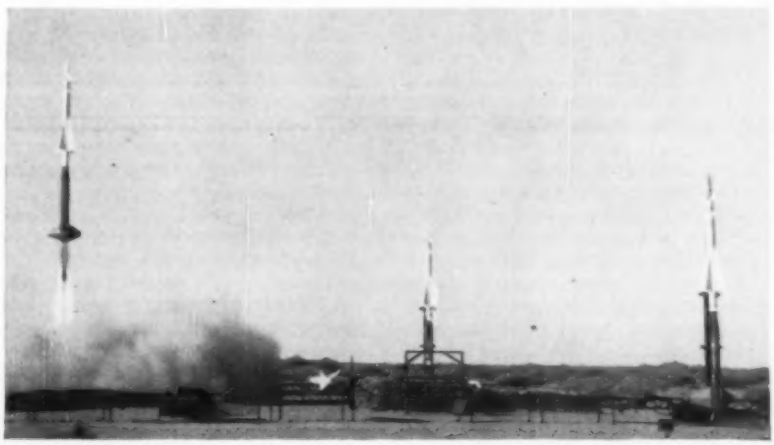
Drone Targets

Criticism of Nike's performance has also centered around the characteristics of the drones being used as targets. Piston-powered, the Radioplane RCATS have a top speed of about 180 mph. and a maximum altitude capability of 25,000 ft. although most of the strikes witnessed were under 18,000 ft. above the terrain.

The facts are that better targets are not available cheaply and in quantity. The OQ-19s cost about $3,000 apiece, even though more than 40,000 have been made. The Firebee costs many times more. Drone B-47s or comparable bombers are out of the question.

To simulate some higher-performance targets, the Army has resorted to firing against manned aircraft with a 1,200 mil (about 65 degrees) offset on the tracking radars. By feeding in this fixed error, they can track a B-45 target plane, fire to a computed point in space and simulate an actual hit on the B-45.

Nikes also have been launched against USAF Matadors, using a fixed miss dis-



RED CANYON Range Camp is site for annual field firing practice for Nike defense batteries stationed throughout the United States.

tance set into the radars to avoid destroying that expensive target.

So until the Army gets a different kind of a target, most Nike rounds will attest to the accuracy of the radar tracking system rather than to the missile's ability to kill an aircraft. This radar accuracy is backed by the Air Force, soon to install Nike radars at testing centers of the Air Research and Development Command where precise location of aircraft and missiles in space is vital to the test program.

"We know the Nike can destroy a bomber if it bursts in the proper location," said one Army Officer. "We also know a .30-cal. bullet will kill a man if it hits him in a vital spot. We don't have to test bullets any more to find that out. Our problem is the same for both: We have to train the man who sights the weapon."

Firings and Scores

Three different kinds of Nike firings were witnessed.

Two research and development rounds were fired at the White Sands Proving Ground. Three batteries were set up for this pair; two of the batteries were from the Proving Ground's ordnance mission, and the third was a field forces Board 4 battery (AW May 28, p. 28).

Two training rounds were fired at Red Canyon Range Camp by Able and Baker batteries of the 44th Nike Package Training Unit. This outfit was the 967th Anti-Aircraft Missile Battalion which has been stationed near Bridgeport, Conn., and was converting from 90-mm. guns to Nikes.

Four annual practice rounds were fired at Red Canyon Range Camp by Able and Charley batteries of the 513th Anti-Aircraft Missile Battalion, usually stationed at Nike sites on Bainbridge Island, Puget Sound, defending the Seattle area. Last year, during the 513th's annual firing practice at Red Canyon, they set a mark of 11 hits for 12 Nike rounds fired.

Nike Box Score

Round by round, this is the way the Nike firings were scored:

• **Round 1,** research and development firing against a Firebee drone. The drone was dropped from a USAF-operated B-26 mother plane at 11,000 ft. altitude above the launching area, and directed in a climbing flight uprange to 70,000 yd. (about 40 mi.) distance. The drone was then turned and began a high-speed run toward the missile launchers. The Nike burst ahead of and under the drone (see picture), scoring hits that tore the fuselage and wings.

The recovery chute deployed and the missile target was recovered. Said the Army: "The strike would have destroyed an aircraft. . . ." Score: one successful strike.

• **Round 2,** research and development firing against a Firebee drone. This second round was fired at the same target as the first round, and was launched before the first had hit. The Nike exploded on the predicted flight path of the target. Score: one successful strike.

• **Round 3,** training round fired by Able Battery 967th AAM Bn., against an OQ-19 RCAT drone. This was the first Nike fired by the battery; the burst deviation from the predicted spot was zero in two of the three dimensions that could be seen on the recorder scopes in the radar van. Flight time to impact was 102 sec.; the target was hit at an altitude of about 16,000 ft. above the terrain and a distance of 45,000 yd. (almost 26 mi.) slant range. Score: one successful round.

• **Round 4,** training round fired by Baker Battery, 967 AAM Bn. against an OQ-19 RCAT drone. This was the battery's first live round; burst deviation was again zero and the RCAT was knocked out of control. Flight time to impact was 81 sec.; the drone was at 10,000 ft. above the terrain and at a slant range of 42,000 yd. (about 24 mi.). Score: one successful round.

• **Round 5,** practice round fired by Charley Battery, 513th AAM Bn. against an OQ-19 drone. The Nike was a successful shot; the burst was within the required design lethal distance, but the drone was not destroyed. Score: one successful round.

• **Round 6,** practice round fired by Charley Battery, 513th AAM Bn. against an OQ-19 drone. The Nike launching phase was successful, but almost at separation of the booster, there was a malfunction in the missile. It failed safe by blowing up its warhead over the booster disposal area. Score: unsuccessful round due to missile malfunction.

• **Round 7,** practice round fired by Able Battery, 513th AAM Bn. against an OQ-drone. Nike made the intercept at 40,000 yd. range (about 23 mi.) and 18,000 ft. above the terrain. The warhead blast turned the target 180 degrees off course, and it then began to lose altitude rapidly. The parachute deployed for recovery. Score: one successful round.

• **Round 8,** practice round fired by Able Battery, 513th AAM Bn. against the same OQ-19 drone that was the target for the seventh round. This round was launched before the seventh had hit; after the seventh Nike had damaged the target, the eighth began to track on the parachute and its burst destroyed the target at 16,000 ft. above the terrain and a range of 41,000 yds. (about 23 mi.). Score: one successful round.

Overall score for the eight rounds fired was seven hits and one malfunction not charged against the score.

ICBM Re-Entry Is Simulated

By Irving Stone

Moffett Field, Calif.—Re-entry of the intercontinental ballistic missile into the earth's atmosphere is being simulated with a new light-gas gun and associated equipment at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics (NACA).

The speeds and temperatures which a full scale missile is expected to encounter in flight are being duplicated using this equipment. The gun propels a model at 10,000 mph. A more powerful version gun, now being designed, will boost the speed to above 16,000 mph.

According to Dr. A. C. Charters, aeronautical research scientist at Ames, the new experimental equipment will permit the study of the various phases of flight such as heating, thermal stress, surface combustion, etc. or will allow the entire flight to be reproduced in a single test. In this way, he says, the features of the missile's flight during re-entry can be explored and solutions sought to the various problems encountered.

Laboratory flight tests with the light-gas gun are very economical with respect to money and manpower in comparison to the requirements of large-scale flight tests, he points out.

The principle of operation of the light-gas gun originated at the New Mexico School of Mines during World War II. This gun used hydrogen as the gas medium. The Ames gun uses helium.

Pumped to Pressure

The helium is introduced into the chamber of the gun at low pressure and then pumped to very high pressure in a single rapid stroke, being heated by the energy of the pumping at the same time that it is compressed. The model is held by a mechanical device until the desired pressure is reached, depending on the launch velocity required. Then it is released and driven down the tube of the gun out into flight by the hot, high-pressure helium.

A typical setup consists of a model and a sabot. The sabot supports the model during its run through the gun tube and flies apart and away from the model's trajectory at the start of its flight.

A model streaks from the gun so fast

Atlas Site Shifted

San Diego—Bowing to Navy pressure, Convair will move the site of its planned $41-million Atlas missile plant (AW May 7, p. 31) from the vicinity of the Miramar Naval Air Station to an alternate point six miles away. The Navy had complained that the facility at its originally-proposed site near La Jolla would interfere with jet operations out of Miramar.

The change in plans will shift the plant to property located near Montgomery Field at a point approximately eight miles from the center of San Diego and delay its completion, originally scheduled for late 1957, between six and eight weeks. The plant will employ 6,600 persons when it goes into full operation in the research, development and production of the intercontinental ballistic missile.

it can be photographed by its own incandescence.

One model employed at Ames is a $\frac{1}{8}$-in. diameter sphere so constructed that it will undergo the same aerodynamic heating as the full-scale satellite vehicle planned for the International Geophysical Year.

Tank Launch

The model is launched into a long tank. Pressure and composition of the air in the tank can be changed to correspond to flight conditions at various points along a re-entry trajectory or a satellite's flight path. In this way, different phases of the flight can be studied under nearly constant conditions.

In another setup, Charters reveals, the tank would be replaced by a supersonic wind tunnel having a long working section.

The model would be launched along the axis of the tunnel against the direction of the wind stream and its flight would be recorded as it traversed the working section.

In this way, Charters says, it is possible to reach extremely high Mach numbers. The present light-gas gun used in the supersonic free flight tunnel at Ames will give a flight Mach number of 20.

The light-gas gun now under design, used in the same tunnel, will give a Mach number greater than 30. This gun would be capable of launching a $\frac{1}{4}$-in. diameter missile model.

Models have been recovered after flight. Recovery is accomplished by having the model pass through a section filled with instant shaving cream and then into ordinary baker's flour.

Telemetering equipment is being designed for use in these small models

Dummy Explodes in Ejection From F-84 at Supersonic Speed

Hurricane, Utah—The unprotected pilot ejected in an F-84 type seat at a sea level speed of Mach 1.32 literally explodes when he and his seat hit the supersonic wind blast. That much is certain from a test run April 27 at Project Smart, supersonic military air research track here.

What will happen to him at speeds up to Mach 2 will be investigated soon, as will be the equipment designed to protect him as Lockheed's "part of the cockpit" approach and Republic's capsule for pilot survival. Both are slated for testing here soon.

Project Smart was built for USAF's Wright Air Development Center, which issues overall general directives for testing. Prime contractor for design, construction and operation of Smart is Coleman Engineering Co., Culver City, Calif., which handles detail test planning and execution. The first run on the track was made last July 8, and some 38 have been accomplished since, from low subsonic speeds to Mach 1.4 at the 5,100 ft. above sea level location of Hurricane Mesa where Smart is located.

The original contract specifies that velocities producing aerodynamic pressures equivalent to sea level Mach 2 must be demonstrated by November, with control within 50 mph. increments in the higher Mach numbers.

Built Atop Mesa

Smart is built atop Hurricane Mesa, which ends in a bluff with nearly sheer sides down to the bed of the Virgin River 1,500 ft. below. The track ends close enough to the bluff's edge to make complete cycle tests of ejection, automatic parachute control functioning and parachute descent operation.

Each of the track's rails is a single welded length. Rails were set in tension to reduce as much as possible the climatic effect upon the track's dimensions, which are held to extremely close tolerances, within 1/10,000 in. in predetermined spots at alignment points, $\frac{1}{8}$ in. of a perfectly straight line along the entire 12,000 ft. length. Anchor spots are 50 in. apart on concrete which is imbedded in the Mesa's bedrock. Standard railroad gage of 56½ in. between rails is used. The crane-type rails weigh 10,105 lb. per yd.

The overall site consists of the track, a control center, an administration-engineering shop building, camera and observation sites and telemeter data gathering installations. The entire sled runs are covered with high speed cameras from several locations to enable fixes of exact positions in space at any point in the tests. Telemetered data is gathered at two positions, the control center and another spot near the bluff's edge where information in the line-of-sight system still can be transmitted from the falling equipment back to the receiving tower. Both sleds and the anthropomorphic dummies are completely instrumented according to the requirements of each test. The control center handles all phases of the test, firing, starting the automatic time signals for film and telemeter data correlation, sounding signals for track personnel, etc.

Solid Propellant

The sleds themselves weigh from 450 to 600 lb. gross weight, depending on the instrumentation of the sled and dummy and equipment being tested. The carriage is a section utilizing solid propellant rockets. However, a 45,000 lb. liquid propellant rocket engine for slower accelerations and higher top speeds is being developed.

Water brakes capable of withstanding more than 100,000 lb. loads are used to stop the sled at the end of the track. Under development by Coleman are brakes effective at loads of 500,000 lb. and higher. Also used to stop both sled and locomotive are aircraft carrier-type water tubes and arresting gear.

The Smart project is a research tool for advancing the state of the art in track testing as well as conducting actual tests. Many developments are coming to light as test-conducting requirements grow. One such has been the trial and error knowledge gained with parachutes in supersonic runs when the sled is allowed to run off the track and over the bluff. Coleman has devised a three-chute combination, a ribbon pilot chute which deploys a 6-ft. guide chute for sled stabilization and deceleration and a main 34-ft. ring slot canopy to lower the sled to the ground. Twice, supersonic runs have ended with the sled being blown up by aerodynamic loads before the guide parachute could accomplish deceleration. Wind tunnel tests of sled and parachute had indicated a successful save, the difference in results pointing up the present state of the art in parachute reactions at supersonic speeds.

In the April 27 test, a late model B5A parachute pack was used. However, the test run results indicated that the safe way to enclose parachutes where the extreme loads of supersonic aerodynamics will be encountered, is in metal containers since the windblast tore the canvas pack open.

Gen. Partridge Warns:

Soviet Bison Outstrips U.S. Interceptor

By Katherine Johnsen

Washington—Gen. Earle E. Partridge, commander of the Continental Air Defense Command, warned the Senate Air Power Investigating Subcommittee that the fighter interceptors on which the U. S. air defense now relies—the F-86D, the F-94C and the F-89—"have inadequate altitude performance to cope with" Russia's Bison intercontinental jet bomber.

Gen. Partridge noted, however, that the introduction of new aircraft and weapons is remedying this deficiency, both in speed and altitude. The Convair F-102, now being introduced into operational units, he said, "will give us vastly improved capability to intercept modern bombers at high altitudes."

He also pointed out that the Hughes Falcon and other air-to-air missiles now being brought into the inventory "will have a marked influence in increasing our interceptor capability at high altitudes."

So far as air-defense missiles are concerned, Partridge said improved models of the Army's Nike will be brought into operation "as soon as possible." The introduction of the USAF's Talos and Bomarc, he said, will further improve our defense.

Two more advanced interceptors, the F-101B and the F-104A Partridge said, will have adequate combat ceiling to cope with the Bison which reportedly has an operational altitude of 57,000 ft. By the end of 1958, he reported, there will be "large numbers" of F-102s, F-101s, and F-104s in the inventory.

Soviet Interceptors Superior

"At the moment the Russian air defense fighters are slightly superior to ours," Partridge said. However, "as new models are introduced into our inventory we will probably enjoy a period of technical superiority insofar as defense fighters are concerned. I am not able to forecast how the future Russian fighters will perform."

The general recommended to the subcommittee, headed by Sen. Stuart Symington (D.-Mo.), that:

- "**It is imperative** that the Air Force push along a program for future fighters which will outperform anything presently programmed to come into the USAF inventory."
- **Development of missiles** to counter intercontinental ballistic missiles is of the same "extreme importance" as the development of the offensive ICBM.
- **The SAGE** (semi-automatic ground environment) system for automatic control of the defense system, now programmed to cover only the continental U. S., should be expanded to cover Canada.
- **Advances must be made** in radars which, at present, do not have sufficient coverage at either low or at high altitude.
- **Air Defense Command** air crews and technical ground personnel should be increased. There should be a minimum of 1.4 crews per operational aircraft, instead of the present 1.0 crew. Insufficient ground crews have made it impossible for the command to properly service and maintain aircraft, engines and complex fire-control systems.
- **Insufficient air bases** have resulted in the crowding of two units onto an airfield intended for only one. Additional hangar space is required to keep expensive aircraft sheltered from the weather.

Defense Costs

The Air Force has a $61 billion, 15-year program (1951 through 1965) for the development of continental defense, Partridge reported. Of this, $24 billion is for capital outlays and $37 billion for operating costs. This does not include costs of the defense programs of the Army and Navy and of Air Force programs outside the continental U. S.

"This program would give us a minimum effective defense against manned aircraft," he said. "It would not provide defense against ICBMs, although parts of the program may well be adapted for this purpose." Expenditures thus far have been less than $4 billion a year, or less than $20 billion total, indicating that the program will require at least an additional $41 billion.

Although a defense against the ICBM "can conceivably be devised," Partridge noted that "this will be one of the most difficult tasks ever undertaken." Two elements, he said, are involved:

- **First, a radar, computer** and communications system which will initially detect, identify and compute track and target information, and alert the counter-missile system. "We have to develop new types of radar in order to get the long distance warning."
- **Second, a counter-missile** system to intercept and destroy the ICBM warhead. "We will be dealing with a weapon going 12,000 to 15,000 mph. and above 500 mi. in height. "It is possible that we will be able to use some of our present ground-to-air missiles in some improved form . . . but this program is only in its early stages."

At present, Partridge said, the USSR has the capability of launching an initial attack against the U. S. with "hundreds of bombers." If the 50 most important targets were successfully attacked, he added, it would bring 40% of the population of the U. S. and 60% of the industry of the country under fire. About 55% of the population and about 75% of industry are concentrated in 170 metropolitan areas.

While conceding that there are numerous deficiencies in his command, Partridge stressed that it "is fully operational and prepared to engage in an all-out air battle at a moment's notice. We hope that the existence of this defensive force may prove a decisive factor in keeping us out of war."

He pointed out that the present defense system was originally set up to combat the threat of attack by the Bull, the Soviet B-29 type bomber. He added:

"Since originally conceived, our air defense system has been modernized as rapidly as practicable to increase its capability so that we might operate against the more recent weapons and aircraft (Bisons and Bears) which the Soviets have introduced. This improvement is still continuing . . . but our present day force is less effective than I should like to see it insofar as both our high altitude and our low altitude coverage are concerned.

He said efforts must be continued in research and development to improve the thrust of jet engines, increase the height and range capability of radars, improve communications and to find an anti-missile against the ICBM and intermediate-range ballistic missile.

Senate Group Restores $3.7 Million to NACA

Washington—The Senate Appropriations Committee has restored $3.7 million of the $5.2 million cut made by the House in the National Advisory Committee for Aeronautics Fiscal 1957 budget requests.

The total $78.2 million approved by the Senate group is $5.5 million more than NACA's budget for the current fiscal year but $1.5 million below the amount requested.

The Senate committee also approved a Fiscal 1957 budget of $3.7 million ($75,000 less than requested) for the Renegotiation Board. This is $475,000 less than the board's budget for this year's operations.

Struggle Between PanAm and Northwest Airlines Before CAB

By Craig Lewis

Washington—The struggle between Pan American World Airways and Northwest Airlines over the Great Circle Route to the Orient is a step nearer final decision with the completion of Civil Aeronautics Board hearings.

In a spirited two weeks of hearings before a CAB examiner, the two airlines continued their long-standing battle over the Great Circle Route in the Transpacific Case. The Board is preparing fresh recommendations on the case for the White House.

In another, quieter hearing for a Great Circle Route, Trans World Airlines and Pan American asked the CAB to give them polar routes to Europe from Los Angeles, San Francisco, Portland and Seattle to match the prosperous route now operated by Scandinavian Airlines System.

Testifying in the Transpacific Case, Pan American Vice President Alvin P. Adams said he believes the Pacific fare level should come down. He said Pan American would propose a $100 cut in fares over the North Pacific if it gets the Great Circle Route.

Northwest opposes a cut because "where there is no increase in seating density or service to compensate for the reduction in revenue . . . a fare reduction of that nature would be a direct path to increased subsidy requirements for the carriers involved."

Pan American wants to operate over the Great Circle routing since it is shorter than the one-stop Central Pacific route the carrier now has. One of the airline's main arguments is that the DC-7C, now coming into use, makes longer-range, non-stop Pacific operations possible.

Adams said that as flying times become shorter, time savings become more significant as competitive factors. "The new aircraft," he said, "will not only expand the United States-Orient market beyond anything previously conceived by reason of the time saving and economies inherent in their use, but they will create a new consciousness of the advantage of utilizing the direct route to the Orient."

Pan American testified that, with both carriers operating over the route, Northwest would make a profit of more than $6 million in the first year of DC-7C operation and Pan American would be able to make a profit of $5 million a year.

Northwest, however, feels that the route is too lightly traveled to support two carriers and that certification of Pan American would cause diversion of $5,176,000 a year from Northwest.

C. L. Stewart, assistant vice president of Northwest, said "the duplication of that route by Pan American would either force Northwest to a position where it would be an ineffective competitor in the Pacific or both Northwest and Pan American would have to rely on substantial government subsidy."

Stewart also said that if Pan American got the North Pacific routing, the carrier would "abandon a great measure of the historic American flag traffic across the Central Pacific route to a foreign flag competitor, thus indirectly our government would also be subsidizing foreign flag competition."

Northwest accused Pan American of not offering the shortest route between California and Tokyo. Northwest said that stopping at Midway Island instead of Honolulu would cut PanAm's transpacific mileage, but Pan American said the Midway routing "just isn't the proper way to operate the route."

In the West-Coast-Europe Polar Route Case, Pan American said there is enough traffic traveling the polar route to support both Pan American and TWA. Pan American estimated that it would carry about 23,000 passengers over the polar route in the first year of operation with a net profit of about $1.2 million.

TWA said it is the logical carrier to get the polar route, and that Pan American should be certificated only if the CAB finds the route will support two American carriers. TWA said that the impact of SAS polar service has cut the American carrier's participation in California-Europe traffic from 50% of the total to 30%.

An initial schedule of nine flights a week—five from Los Angeles and four from San Francisco—was proposed by TWA. The airline said traffic on its single-plane service from the West Coast to Europe via New York has been disappointing, and the service would probably be dropped if TWA gets a polar route.

USAF Revamps Rescue Service

Washington—The Air Force last week ordered a streamlining of its Air Rescue Service which will provide greater coverage, cut costs considerably and shift emphasis from fixed-wing aircraft and crash boats to helicopters.

The order will mean the purchase of a number of new helicopters, but the Air Force said it does not yet know how many it will need. They probably will be small, versatile two-place craft equipped with stretchers and assigned primarily to the rescue mission.

An Air Force spokesman said the reorganization calls for a shift from a few large, self-sufficient air rescue units at relatively few bases to a program of "versatile air rescue detachments dispersed throughout the country." Helicopters, the spokesman said, will be used at "55 bases in the U.S. and at designated overseas bases."

Four Air Rescue Service Group Headquarters (at Albrook AFB, Canal Zone; Hamilton AFB, Calif.; Westover AFB, Mass., and Wheelus AFB, Libya and nine ARS squadrons will be eliminated. The squadrons are stationed at March, McCord, Lowry, Ellington and Selfridge AF bases in the U.S. and at Albrook, Ramey AFB in Puerto Rico, Kindley AFB in Bermuda and Dahran AFB in Saudi Arabia.

The streamlining resulted directly from a study of air rescue work in recent years and indirectly from the fact that the Air Coordinating Committee's new National Search and Rescue Plan (AW Apr. 16, p. 132) gives the Air Force responsibility for inland areas, leaving the maritime region to the Coast Guard.

The study revealed that:

- **About 70% of all** Air Force aircraft accidents occur within a 20-mile radius of an Air Force base.
- **Helicopters recovered** 19% of all persons rescued from the water after aircraft accidents, whereas crash boats rescued only 3%.

The significance of the last figure is pointed up by the fact that the Air Force had 10 times as many crash boats in rescue service as it did helicopters.

Crash boats now will be eliminated from ARS. Since they were assigned to bases, rather than ARS units, they will either remain in service (for target surveillance, etc.) or be turned over to the Navy.

The Air Force said the reduction in the number of fixed-wing aircraft under the new concept will "not be material."

Air Force estimates are that it can save $18.7 million annually and release 2,033 personnel from ARS work by the time the streamlining is completed.

Gen. Nathan F. Twining, USAF Chief of Staff, said the new concept results from "technological advances and years of daily experience."

An Air Force spokesman said two factors are the increase in injuries to pilots who bail out at high speeds and the smaller amount of survival gear they can carry in the newer planes.

Aviation Writers Assn.

ATA President Tipton Criticizes CAB Airline Fare Investigation

San Francisco—The Civil Aeronautics Board was charged by the Air Transport Association last week with starting its investigation of general airline fares for the wrong reason.

"The Board gave an alleged high level of airline profits as the reason for its concern," Stuart G. Tipton, president of ATA, told the Aviation Writers Association.

Asserting that the CAB did not say rates were too high, Tipton decried the use by the Board of the rate of return on investment as the formula for determining justifiable profits.

"Instead, the Board must face up to the real question: How much money do the airlines need to do their job? The Board must answer that," Tipton said, "and then be prepared to support and defend the industry in getting that much money."

Trunkline earnings from all sources for the last ten years were about $1,760,000,000, Tipton said. Of these funds 82% or $1,480,000,000 was ploughed back into new and better equipment.

Only $91 million, about 5%, was paid out in dividends, Tipton said, and "a large portion of those dividends was paid to preferred stockholders. . . . Virtually mandatory from a credit standpoint."

Tipton cited these other facts:

• **Airline** dividend payouts amounted to 32% of net profits after taxes, compared with 47% for all U.S. corporations.

• **Although** a growth industry, airline equities have increased only 25% since 1946. Other growth industries have shown spectacular gains: chemicals 239%, aircraft manufacturing 362% and aluminum 476%.

• **Air fares** today are just about level with those of 1938, despite cost increases including a 235% increase in airline wages and an over 90% increase in consumer prices.

• **When the airlines** buy new equipment, they contribute them to the civil reserve air fleet, ready to be called on government service in emergencies.

"This country can continue to have the greatest airline system in the world if only our government recognizes the great public issues with which it is dealing, recognizes the disaster that can come from errors, the national benefits that can flow from sound policy," Tipton declared.

His conclusion forecast an aggressive campaign by ATA: "Perhaps it is high time that the airlines came at the CAB with the powerful arguments which must convince the Board of the special needs of an air transportation system and give the Board an opportunity to assume its grave responsibilities."

F5D Exceeds Mach 1 In First Flight

San Francisco—The Navy's Douglas F5D Skylancer exceeded the speed of sound on its first flight recently at Edwards AFB.

Wing planform, general appearance and arrangement are the same as the F4D. Equipped with the Pratt & Whitney J57 engine, the F5D has been designed for greater speed, range and performance. The Skylancer will be a multi-purpose fleet airplane, serving either as a day fighter or all weather interceptor.

F5D aircraft will begin coming off the Douglas El Segundo production line in about nine months. Procurement is expected to be supported in part by transfer of funds from the F4D program.

Missile, Satellite Products Useful

By Alpheus W. Jessup

Moffett Field—Civil aviation and civilian life will receive major benefits in the years to come from the by-products of missile and satellite technology, Hall L. Hibbard, vice president and general manager of the Lockheed Aircraft Corp. Missile Systems Division, told the Aviation Writers Association.

Hibbard predicted that the wing of the F-104A Starfighter would some day appear again enlarged in scale as the wing of a supersonic commercial transport. The F-104 wing, he said, "came straight from a missile we have been flying for some time." Another benefit to civil aviation, Hibbard said will be techniques and equipment to handle the three-dimensional air traffic jam "when the air will be full of jet liners, vertical rising jalopies, helicopter drays, and so on. . . .

"In the process of working out the automatic flight and guidance systems, and data control and reduction systems for missiles, they (the missile boys) are solving the problems and building the equipment to control this mass of air travel of the future."

He also predicted that mail and freight rockets will be in use within the U.S. and on world routes.

Hibbard listed practical applications of satellites in:

• **Navigation.** Ideal celestial reference points with built-in visibility to radar could be positioned where they are wanted. Then automatic piloting of manned and unmanned vehicles with unprecedented precision would be possible.

• **Communication.** Properly placed satellites could reflect or broadcast signals free from line of sight limitations.

• **Meteorology and climatology.** Satellites put up where they can observe the whole panoramic sweep of the weather as it forms and moves will enable the weatherman to make absolutely dependable forecasts. Eventually we may "learn enough about cosmic rays, solar phenomenon, magnetic storms and meteoric dust" to forecast long-range weather cycles and "maybe even do something about them."

Besides these direct uses of missiles and satellites, missile technology under the pressure of the weight problem, will lead to new electronic equipment that will be cheaper, smaller and better. The applications will be made to many unexpected things—watches, pocket television sets, instant communications to anywhere and robot machines to handle housework.

Hibbard predicted that the missile men will turn up new sources of cheap and massive energy. With their problems simplified by having no humans aboard their missiles, they may perfect "fully effective applications of nuclear, solar and other energy well before it is done on land or in conventional aircraft."

Plant Mills Steel, Titanium Chemically

Los Angeles—The first pilot plant for the chemical milling of steel and titanium is in operation here, turning out parts for the North American SM-64 Navaho intercontinental guided missile.

The plant, located at the facilities of Turso Products, Inc., is being operated by the company in a joint research and development effort with North American Aviation, originator of the patented Chem-Mill process.

A production line for chemical milling steel and titanium with a capacity of 200 parts per week, will begin operation at North American's Downey plant in September.

DC-8 Climb, Cruise, Fuel Use, Speed Is Described by United

San Francisco—Operational characteristics of the Douglas DC-8 which United Air Lines will operate beginning in the fall of 1959 were projected for Aviation Writers Assn. United will be the first to operate these jet transports.

W. E. Rhoades, UAL manager of flight engineering, said:

- **DC-8 takeoff** will be somewhat conventional, except quieter than usual for up-front passengers.
- **Initial rate** of climb will be very much like today's planes until the DC-8 accelerates to 290 kts., its best rate of climb speed. From this point, rate of climb will be 2,000 fpm. or higher, depending on the load. Low-altitude turbulence will be traversed in about two or three min.
- **Plane will reach** 30,000 ft. in 15 to 17 min. The heavy, long-range version probably will level off between 25,000 and 30,000 ft. for first stage cruise and, after some fuel is burned to lighten the load, the plane will climb to 35,000 ft. for final stage cruise.
- **Climb** to the 30,000-ft. altitude will require about 1,200 gal. of fuel. Average fuel consumption for cruise will be about 2,200 gal. per hour.
- **At 30,000 ft.**, the flight would be above most of the weather, except thunderstorms. Very few large hailstones would be encountered, and no bird strikes.
- **Better methods** will have to be evolved to find jet streams when the plane is traveling eastbound, and to avoid them when flying westbound.
- **Actual flight-time** San Francisco to New York, will be about 4 hr. 40 min. plus about 15 min. for ground time. Westbound flight time will be about 5 hr. 35 min. with 15 min. more for ground time.
- **Plane will be pressurized** from sea level up to about 23,000 ft. This will be an operational necessity in order to get passengers down comfortably, since normal rates of descent of the DC-8 may be from 4,000 to 5,000 fpm.
- **Descent for straight-in** landing will be made from cruising altitude in 7 or 8 min.
- **Passengers would have** panoramic view, unobstructed from most seats.

Russian Researcher's Pay Cut by 50%

The high pay scale for Russian research scientists and teachers in higher educational establishments has been cut by 50%.

The action was taken for two major reasons: to channel some of the nonproductive researchers into productive industrial jobs, and to appeal for more support from the industrial and managerial elite now being created by the present regime in Russia.

First rumblings against inequities in the wage system were heard at a conference of industrial managers last summer. The 20th Party Congress aired further criticisms. Final blast was published in Komsomol'Skaya Pravda as an official doctrine.

Major complaint of the newspaper article seems to be that some Red researchers are living on the degree and the salary they established some time back, rather than continuing to be producers of scientific thought.

Under the old system, a researcher achieved his advanced degree after his dissertation, and almost immediately became one of the scientific elite with salary perhaps two or three times as much as an industrial plant manager. In fact, Russia is probably the only country in the world where a college professor or researcher is at the top of the wage-earners' list.

The ease of getting by the single barrier of the dissertation to a green, lazy field of low productivity and high salary has been recognized by young Soviet students who have aimed at degree-gathering. The article cites some of the cynical comments circulated among young scientists: "A degree is power;" "What is important is not knowledge, but a degree;" "On to degrees."

Twining to Visit USSR

Washington—Gen. Nathan F. Twining, USAF Chief of Staff, last week accepted Russia's invitation to attend the Soviet Aviation Day celebration in Moscow on June 24.

The announcement of Gen. Twining's acceptance, made upon the personal direction of President Eisenhower, said he will be accompanied on the trip by "several Air Force officers." Originally, the administration had held back a reply in the hope that the invitation would be extended to include other members of the Joint Chiefs. Such an invitation, however, apparently was not forthcoming.

Bonanza Orders Fairchild F-27

San Francisco—Bonanza Airlines became the sixth operator to order the Fairchild F-27 turboprop airliner last week. Its order for three Friendships raised the total of firm orders to 17.

An option for an additional three increased the options to 23.

Tooling at Fairchild's Hagerstown plant has just been started and the first metal will be cut in about one month. First flight of an American-built model of the Fokker-designed short-range transport will be made between June and August next year.

Originally, Fairchild's board of directors specified that firm orders for 40 aircraft had to be in hand before large scale production tooling could begin. This has recently been modified, and sales can now be contracted for without the minimum order escape clause.

Two months remain before the production tooling decision has to be made. By that time, Fairchild expects it will have firm orders in hand for close to 80 aircraft.

First, executive transport sale is about to be announced. One corporation has already received approval from its board of directors to make a Friendship purchase. Another West Coast airline has verbally committed itself to a small Friendship order.

Europe Fights Fare Cuts

Cannes—Bitter European opposition to American proposals for new low third-class transatlantic fares flared at the International Air Transport Association annual rate meeting here last week.

Before IATA conference opened, the civil aviation chiefs of 14 European countries met in Paris and issued a joint policy statement opposing the American proposals. They indicated they would request their governments to take action under bilateral agreements with the United States if American carriers began an Atlantic rate war next spring by introducing the proposed third-class fares and service. Countries supporting the opposition policy include France, Britain, Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Ireland, Norway, Holland, Sweden, Switzerland and West Germany.

Rene Lemaine, French civil aviation chief who presented the opposition policy to the IATA delegates, said European airlines needed more time to adjust to the jet age; lacked fleet flexibility to offer a new type service, and feared lowering of fares would reduce their already critical net income levels.

Army Outlines Aviation Program, Sees No Conflict With USAF

By Evert Clark

Washington—Army Aviation's toughest job—reflected in its budget presentations to Congress and a recently-released outline of its five year plan—is to convince the Joint Chiefs of Staff, the Air Force, Congress and the public that it can continue to grow without infringing on Air Force operations.

The Army presented its five year plan to the Joint Chiefs some week ago —largely in an attempt to make it clear that the Army's program in the air is not competitive with that of any other service, according to Maj. Gen. Hamilton H. Howze, director of Army Aviation. The Joint Chiefs still have it under study.

Gen. Howze said the Army has not yet asked for any change in the 1952 Memorandum of Understanding—which limits the size of fixed-wing Army aircraft to 5,000-lb. empty weight—and will not ask for any in the near future.

Other Army spokesmen indicated no change will be asked for until some successful research and development program produces an aircraft feasible for Army use and over the weight limit. Then, with a specific aircraft to talk about, Army would make its request with a reasonable expectation of success.

Although that probably will not come in the near future, it is quite likely to come before the end of five years.

So far the public has not seen the five year plan, although Gen. Howze briefed at least one congressional committee recently. Most of his comments on details of the plan were off the record.

The Army has released an "Army Aviation Fact Sheet" which it says sketches the broad general outline of the five year plan. The fact sheet contains little detail.

It generally bears out Gen. Howze's statement in an interview that the five year plan "is merely a methodical outline for our own development along present lines, and not a departure from previous concepts"—or an attempt to move into Air Force territory.

It mentions the Army's interest in a faster, short-takeoff observation plane, but describes it in far less detail than Gen. Howze described it to Congress (AW May 14, p. 31). Development contracts will be let for this plane by the Navy as soon as details are worked out between the Army and the Marine Corps, which also has a requirement for it. Army and Marines have agreed on almost all points but Army favors tandem seating, with "one head above the other" for better visibility, and Marines favor side-by-side.

The fact sheet also notes that the Army has "under study" a possible requirement for "a relatively small fixed-wing transport aircraft (3 to 5 tons payload)" to "increase significantly the mobility of ground troops, not only in the rear areas but in the area of contact with the enemy."

Although the fact sheet says the Army "may" have this requirement in the future, it also notes that "considerably greater dependence" must ultimately be placed on the fixed wing cargo aircraft such as those mentioned above "for moving troops from the place where Air Force transports leave them to "small units of the field army."

Gen. Howze insists that the Army program is "sound, reasonable and moderate" and says he is convinced that most Air Force objections to the Army's aviation plans come from "a misunderstanding."

He says the new observation plane is "not in any way an attempt to conflict with Air Force tactical reconnaissance;" the Army's desire for "unconditional command" of its aircraft during combat can be worked out by agreement with Air Force and advancements in electronic techniques (for example, the use of transponders) and improved tactical air traffic control; and that he would leave "all long-range troop movement" to the Air Force.

What the Army objects to and would like to get rid of are "arbitrary limitations"—presumably in pounds and miles —which keep the Army from performing missions which unquestionably are assigned to it, he said.

Mach 1.2 Bomb Drop Confirmed by Navy

Washington—The Navy said last week that a naval aircraft in level flight has successfully released a bomb at a speed of Mach 1.2, confirming an AVIATION WEEK report of Feb. 13 (p. 25). This is the highest speed ever recorded for such a drop.

The drop was accomplished with a small, lightweight explosive bolt developed by Modern Metal Crafts Co. of Philadelphia for the Bureau of Aeronautics. The device, tested at the Naval Air Test Center, Patuxent, Md., enables the bomb to make a routine trajectory, overcoming the tendency to remain with the aircraft in supersonic releases.

The bolt is cut in half by a self-contained powder charge.

Military Aviation Funds

The three military services had an unexpended balance on hand, as of Apr. 1, of over $21 billion for aircraft, guided missiles and electronics equipment. Following are details reported by the Department of Defense (000 omitted):

	OBLIGATIONS		EXPENDITURES	
	July 1, 1955 to Apr. 1, 1956	Unobligated Balance, Apr. 1	July 1, 1955 to Apr. 1, 1956	Unexpended Balance, Apr. 1
Aircraft and Engines:				
Air Force	$2,761,224	$6,252,551	$3,796,325	$11,599,190
Navy	1,173,132	2,230,118	1,180,779	4,972,422
Army	19,101	137,917	70,091	326,615
TOTAL	3,953,457	8,620,586	5,047,195	16,898,227
Guided Missiles:				
Air Force	605,256	530,565	406,823	1,251,661
Navy	163,459	191,887	133,981	450,548
Army	273,237	169,277	288,861	819,011
TOTAL	1,041,952	891,729	829,665	2,521,220
Electronics & Communications Equipment:				
Air Force	256,006	768,961	384,789	1,328,337
Navy	96,851	115,961	69,132	299,887
Army	78,765	87,149	108,444	424,226
TOTAL	431,622	972,071	526,365	2,052,450

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U.S. Tries to Boost Confidence In NATO at European Air Show

By Claude Witze

Zurich—Against discouraging odds and an obvious Soviet effort to put its docile foot forward, the U.S. Air Force and Army displayed their aircraft and missile might at the two-day International Air Show here in an effort to bolster waning European confidence in the power of the North Atlantic Treaty Organization.

While European newspapers were giving wide publicity to statements outlining U.S. weaknesses by Gen. Curtis E. LeMay, Strategic Air Command commander, and Gen. Earle E. Partridge (see p. 30), the Air Force made these counter moves:

- **Unveiled the first** operational USAF F-100 Super Sabre unit in Europe at a Bitburg, Germany, press conference on the eve of the air show. The conference was attended by 180 reporters from seven nations.
- **Flew the F-100** at supersonic speed before an air show crowd of 500,000.
- **Gave European audiences** their first view of the B-47 medium-range jet bomber and the Martin Matador tactical missile.

The Army put on exhibition the Nike anti-aircraft missile and the Corporal and Honest John ground-to-ground missiles.

The Nike unit had been rushed from the U.S. on two-weeks' notice in an obvious Defense Department effort to offset slackening European interest in NATO in the face of Russia's new, "peaceful" look, and to reawaken confidence in U.S. strength.

The Russian tack for prestige was directly opposite.

Soviet military aircraft were conspicious by their absence. Russia relied, instead, upon its already highly publicized Tu-104 twin-jet transport.

During the first day of the show, the silver jet remained on static display, with only a limited, and apparently select, number of guests allowed to enter it.

On the second day, the Tu-104 took to the air for two passes—one at no more than 300 ft. over the crowd.

Experts at the show were impressed by both displays, but the U.S. had the larger selling job.

Along with the testimony of LeMay and Partridge, European newspapers were giving prominent mention to threats in some quarters of Congress to cut off support from NATO nations which have failed to carry out their commitments, and a statement by the new NATO commander, USAF Gen. Lauris Norstad, that his forces are still below the necessary minimum.

To point up the improvement of U.S. forces deployed in NATO countries, Maj. Gen. Robert M. Lee, commander of the 12th Air Force, and Col. John A. Brooks, commander of the 36th Fighter Day Wing, said at the Bitburg press conference that USAF air power in Europe is now all-jet, including the Martin B-57, RB-57, F-86, F-84F and the Matador.

They also pointed out that the arrival of the F-100 makes supersonic combat operations possible for the first time and is a "signal of the intention of the Western nations to put forth the utmost in defense of freedom."

U.S. Latin American Show Is Rescheduled

Washington—The two-day international symposium aimed at aggressive promotion of the U.S. aircraft in Latin America postponed earlier this year after arrangements already had been made (AW Feb. 6, p. 28) is now scheduled for Nov. 14-15 at Miami.

The conference originally was planned for February by the Aircraft Industries Assn.'s Export Committee, working with John Payne, AIA's export director. After DeWitt Ramsey, president of AIA, called off the meeting, saying it needed further study, Richard B. Swanson, Washington representative of Convair, resigned as AIA Export Committee chairman.

New committee chairman is Charles H. Shuff of Western Electric International Corp.'s New York office, who was vice chairman under Swanson.

Payne is retiring from his AIA post this month. He is being succeeded by Irving H. Taylor, an associate.

Civil and military aviation leaders from Latin American countries have been invited to the symposium. Its purpose is to provide U.S. industry representatives with a better idea of the potentialities of the Latin American market, where European aircraft manufacturers have been making substantial sales in recent years.

French Plan to Build Atomic Plane Engine

Two years after a government announcement that the French were planning to construct an atomic airplane engine, the first step has been taken toward the realization of the project. A new division devoted to the study of an atomic engine has been created at Snecma's Suresnes plant, just outside of Paris.

To direct the work of the atomic study laboratory, Snecma has appointed Raymond Marchal, chief engineer of Snecma and one of the leading French aviation technicians. For the past eighteen months, Marchal has been detailed to the French Atomic Energy Commission's research center at Saclay where he has been studying the latest developments in French nuclear research.

Snecma refused to give any further information beyond the fact that it would "probably not work along the same lines as the Americans."

Chance Vought Awarded New F8U-1 Contract

Washington—The Navy has awarded Chance Vought Aircraft, Inc., a $20 million contract for additional production of fighter and photographic versions of the F8U-1 jet Crusader. Previous production contracts of $45 million were awarded in March, 1955, and $100 million was awarded in December. The contract increases the total amount of Crusader contracts awarded since Chance Vought won a design competition in May, 1953, to $250 million.

News Digest

Douglas F5D now equipped with the J57 eventually is expected to get the J79. General Electric is now flight testing the J79 in an F4D. The J79 is expected to provide the F5D with an operational ceiling in excess of 60,000 ft.

Convair will build an F-102B with the J75 engine under a new $83 million USAF contract in an effort to match the altitude of the Russian Bison bomber. First flight is scheduled before the year end. The F-102A with the J57 has flown at 54,000 ft., 2,000 better than expected but much less than what is considered necessary.

Tactical Air Command may eventually receive a fighter-bomber version of the Lockheed F-104 Starfighter. TAC has established a Starfighter project.

USAF Thunderbird aerobatic team is converting to North American F-100C Super Sabres and will make its first demonstration of the Super Sabres late next month in Florida. Thunderbirds have been flying Republic F-84Fs.

Official nomination of Garrison Norton as assistant Secretary of the Navy for Air (AW May 28, p. 25) was

announced last week by Navy Secretary Charles S. Thomas. At the same time, Thomas confirmed the resignation from that post of James H. Smith, Jr. Thomas said Smith, an assistant secretary since July, 1953, originally had accepted the position for a period of two years and had then, "at the personal request of the Secretary," agreed to stay on for an additional year. Norton, who has been a research and development consultant to the Secretary of the Air Force since 1952, is a Naval Reserve aviator and served as assistant chairman of the Civil Aeronautics Authority in 1938.

Beech Aircraft Corp. has been awarded $500,000 contract by Lockheed Aircraft Corp. for additional T-33 jet trainer wings, supplementing a $3-million follow-on production contract received by Beech in January.

Semi-automatic translation of Russian technical articles into English on a word-for-word basis is goal of new development being launched at International Telemeter Corp. under Rome Air Development Center sponsorship. As human operators type out words on Russian-alphabet keyboard, an adjoining electric typewriter will type out English equivalent. Russian-English word equivalents will be stored on high-speed rotating disc, capable of storing five million characters and extracting any word in 50 milliseconds.

National Aviation Corp. offering of 139,523 shares of capital stock to stockholders at $30 per share and ratio of four to one was oversubscribed. Primary subscription rights took up 136,411 shares. The remaining 3,112 shares will be alloted among 59,056 subscriptions pro rated as primary subscription rights were exercised.

Nike missile will be produced at Charlotte Ordnance Missile Plant, which was dedicated recently. Douglas aircraft company will operate Army-owned plant as its fifth division. Rehabilitation from former quartermaster depot cost $22 million.

Price cut of more than 30% for fluorocarbon rubbers, which has uses in containers for guided missiles, are effective this month. New price for Kel-F elasomer starts on sliding scale at $15 lb.

First Canadian privately sponsored environmental test laboratory is open at PSC Applied Research Limited plant in Toronto. Offered Canadian industry for the first time: icing wind tunnel, altitude temperature chambers, shock, salt fog and radio interference tests. To be added: equipment to test effects of sand and dust, explosions and fungus growths.

Fang Stayed in Mockup Stage, But Paid Test Bed Dividends

By Richard Sweeney

Hawthorne, Calif.—Northrop Aircraft's Fang (N-109), a proposed single place, high altitude supersonic fighter, never got beyond the mockup stage. But the company has found it an invaluable engineering aid since it was designed for growth without modification and for a high degree of flexibility and maintainability, using new approaches and principles.

Fang design started in May, 1953. The mockup was done in September of the same year, and has been in use as a test bed for ideas since.

Innovations in principle and design include:

• **The turbojet** engine was not mounted within the prime structure, it was attached underneath. Either the J65 or J79 could have been used, and the change could be effected in the field using a kit.

• **Hinged sections** were used extensively, insuring a very high degree of equipment accessibility and maintainability.

• **Equipment** people were allowed to place their hardware in the aerodynamic envelope in easy access locations, and structures were designed around them afterward.

• **A delta** (low aspect ratio) wing 5% thick was used, but a horizontal stabilizer was incorporated to obtain higher accelerations at high altitudes and Mach numbers than had been possible with pure delta designs.

• **The plane** featured eight interchangeable armament installations (Gatling-type cannons, 2.5 in. and other sizes of rockets, guided missiles and combinations thereof). Changeover was by kit, and could be accomplished in the field.

• **The combination** of hinged panels, kits for reloading and servicing of armament, single point high pressure refueling, resulted in a combat mission turnaround time of six minutes from touchdown to takeoff.

Light Weight

The Fang was a light (15,000 to 18,000 lb.) aircraft, with wing loading on the order of 55 lb. per sq. ft. A top speed of Mach 2 with the ultimate (J79 or better) powerplant was planned. Using the zoom technique of trading speed for altitude, a maximum altitude of at least 70,000 ft. was expected.

Structurally, Fang used four main fuselage longerons and stressed skin in the center and aft sections of the fuselage for a box.

Since some sections of what otherwise would have been stressed skin were hinged sections and non-load bearing, a vertical shear web was incorporated in the forward part of the upper fuselage just aft the cockpit, separating two equipment locations.

The engine suspension system was hung below the aft-central fuselage box structure, making installation of multiple engine mounts for different powerplants easy in original production without too great a weight penalty. The engine enclosure was in reality just a large cowling, hinged in all sections for easy engine access.

For different engines, different cowls could be used without any modifications whatsoever since attachment to the main fuselage structure was along a hinge point.

Duct Configuration

Air duct configuration could be changed at will to suit engine requirements since it too was merely attached to primary structure rather than being a part of it.

In equipment placing, those items requiring least service were installed just aft the cockpit in the fuselage. Access was through a uniquely fastened, hinged and rotable section of part of the wing leading edge and fairing and fuselage side panel.

The top of the fuselage forward of the instrument panel also was hinged for easy access to the back of the instrument panel and electronic gear in that area.

The nose section was similarly hinged for access to radar and related electronic equipment.

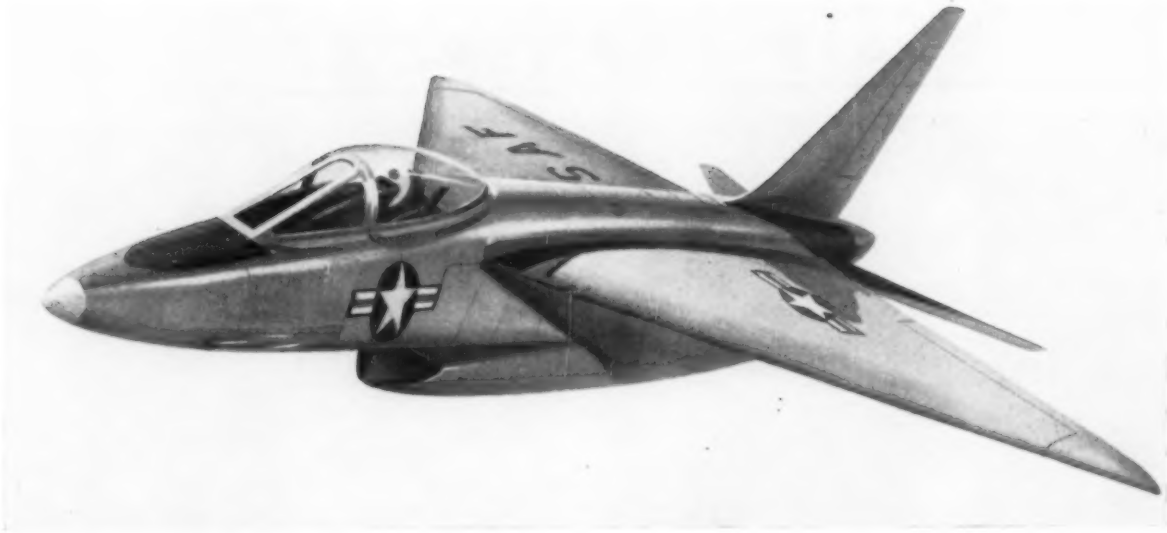
Plastic Tubes

Gun blast tubes were of plastic with stainless steel innerliners. When a tube burned out, it was thrown away and a new tube installed due to the low cost. In addition, the plastic design in that area made armament changeover by kit easier since the proper section for the type of armament could be easily and quickly installed from the kit. Any of the eight armament changeovers could be made in a maximum of eight man hours, two men working four hours each, one on each side.

Fuel was carried integrally in the wing, and in bladder tanks in the fuselage, since the high mid-wing used a straight through structure.

Fang would have cost more initially per pound of airframe weight than conventional designs.

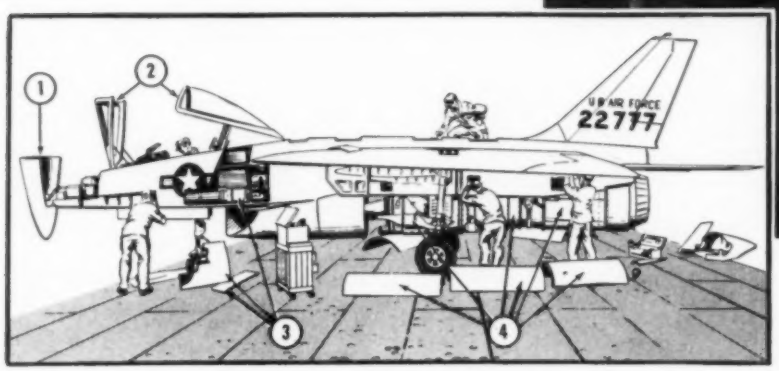
However, in the life span of an airplane, its growth usually is accom-



plished through costly modification programs. The Fang philosophy evolved by Edgar Schmued, Northrop vice president-engineering, would have cut the modification costs considerably, resulting in the plane's complete growth cycle being accomplished at a much lower life-span-of-the-design cost.

The design was accomplished under the direction of Welko Gasich, Northrop chief of preliminary design.

Many Fang innovations will be included in future Northrop designs, and the first undoubtedly will be the supersonic trainer now under construction.



ARTIST'S conception of Fang in flight (top) shows split air intake for use with J79 engine at supersonic speeds. Extensive hinging (right) shows use of easy access theory. Nose (1, below) provides access to radar and forward electronic gear; fuselage (2) opens to back of instrument panel, other electronic gear; armament panels (3) open for kit servicing or firepower changeover, and (4) engine cowls can be removed for service engine change or installation of a different type of engine

DC-7C Lengthens Transocean Stride

Three spectacular proving flights precede the first scheduled nonstop New York-to-Paris service.

By Robert Hotz

New York—Pan American World Airways began a new era of transatlantic operations last week with first regularly scheduled nonstop New York-Paris service using the Douglas DC-7C.

Regular DC-7C passenger service was preceded by three spectacular proving flights that saw the new transport stretch its legs to set three new nonstop commercial records between the United States and European terminals. They were:

- **4,800 mi. nonstop** from Miami to Paris in 13 hr. 55 min., averaging 350 mph. ground speed and burning 7,135 gallons of the 7,824 maximum fuel load. Reserve over Paris was sufficient to use Madrid or Frankfurt as alternates.
- **4,060 mi. nonstop** from Frankfurt to New York in 13 hr. 30 min. averaging 300 mph. ground speed against an average 15 mph. headwind. Fuel consumption totalled 6,700 gallons leaving enough to use either Chicago or Atlanta as alternates.
- **4,300 mi. nonstop** from Rome to New York in 16 hr. 51 min. averaging 258 mph.

First two flights were operated by a Pan American flight crew commanded by Capt. C. N. Warren, chief check pilot, Atlantic Division, with Capt. A. O. Powell, assistant chief pilot, administrative, Atlantic Division as first officer and carried 53 newspapermen, airline officials and Douglas Aircraft Co. executives. Takeoffs were made at current maximum gross weight of 140,000 lb. and the flights were conducted under standard cruise conditions, pulling 1,700 cruise horsepower from each Curtiss-Wright R-3350 EA1 compound engine.

Strong Impact

Step climb procedure was used, the first four hours flown at 13,000 ft. before climb to cruising altitudes above 20,000 ft. The Rome flight was the end of a DC-7C proving flight covering all European terminals to be used by the new transport. It was conducted under long-range cruise procedures using less cruise power for better fuel economy.

Technical observers aboard the preliminary DC-7C transatlantic crossings were convinced the new transport will have a strong impact on long-range transport operations in the years remaining before turbojet transports go into service.

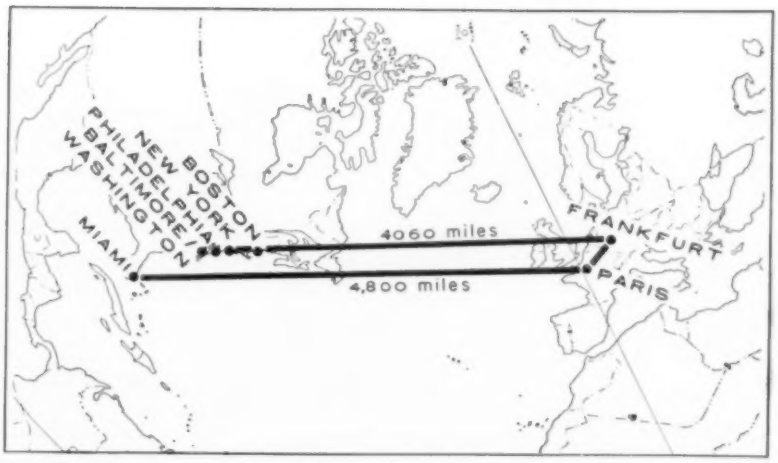
First reaction to the new nonstop pattern came from Ireland where the Irish government, apparently irked by the DC-7C ability to over-fly Shannon, refused permission for the press flight to fly over Irish territory on the way to Paris.

Pan American will be relying heavily on its DC-7 fleet, the B model that began entering service last year and the C model, to boost its transatlantic seat capacity from 80,000 in 1955 to a record 100,000 this year. In addition to the five deliveries already made to PanAm for the Paris service begun June 1, Douglas is still operating three DC-7Cs for development testing.

Pan American is scheduled to get deliveries of two a month until next March when its fleet of 25 planes will be complete. Early deliveries by Douglas enabled Pan American to get the DC-7C into regular service a month ahead of its July 1 target date. Present schedule calls for 11 hr. eastbound, 14½ hr. westbound.

Scandinavian Airlines System will be the next airline to get the DC-7C. Initial deliveries are scheduled for July.

Pan American is particularly pleased with the cabin flexibility of the seat



NONSTOP flights to Paris, New York prove DC-7's long-range.

tracks and removable bulkheads of the DC-7C that enable a quick change to each of three cabin arrangements the airline plans to use. They are:

- **76 passenger** tourist version now in service to Paris. This has a three-and-two seating arrangement with 38-in. interval between seat rows, fore and aft lavatories, and a mid-cabin galley and lounge.
- **104 passenger version** that will be used for Pan American's third-class service if its proposed low fares are approved by the International Air Transport Association traffic conference in session at Cannes.
- **Combination first-class** sleeper service in the rear cabin, tourist accommodations forward for low density routes such as the South Africa, Scandinavian and round-the-world services.

Sooner and Better

The speed with which Douglas and Pan American put the DC-7C into airline service is characteristics of the pace with which the entire project has been handled. The project was first conceived June 7, 1954, by the Douglas engineering group headed by J. R. McGowen, who directed DC-6 and DC-7 series engineering. Corporate approval was given by Donald Douglas and the first conferences were held with Pan-Am President Juan Trippe and his technical advisers by June 15.

PanAm's initial approval was received just three weeks after the DC-7C project was conceived although a formal contract for 15 aircraft was not signed until a month later. In a span a week short of two years from conception the DC-7C went into regular airline service.

Pan American expects to put the DC-7C into Pacific service by September and hopes for approval of Great Circle course operations to the Orient for this transport. The DC-7C can make a Seattle-Tokyo run of 4,770 mi. nonstop and a one-stop run from Seattle to London via the polar route.

Coming at the end of the long Douglas DC-6 and DC-7 series development, the DC-7C has emerged sooner and better than originally scheduled. Douglas deliveries to Pan American began six weeks earlier than anticipated.

Certification Performance

Total of 105 DC-7Cs have been ordered by 12 airlines, representing about two years production of this type on the integrated DC-6 and DC-7 production line at the Douglas Santa Monica Division. By next year this line will be delivering 14 transports a month.

Certification performance of the DC-7C has exceeded its original sales contract guarantees by a significant margin and a number of improvements are still being cranked into the aircraft for even better operational characteristics.

Among the various areas where performance has exceeded guarantees are:

- **Gross weight** up from 139,000 lb. to 143,000 lb. with 144,000 lb. as its maximum performance limitation.
- **Take-off distance** cut from 6,950 ft. to 5,820 ft. at maximum gross.
- **Landing distance** has already been cut 50 ft. to 5,350 ft. at 107,000 lb. aircraft weight with additional improvements aimed at bringing the landing requirement to 5,000 ft., or less than now used by the DC-6B.
- **Rate of climb** has been increased and stalling speed lowered.

Engine improvements proposed by Curtiss-Wright will increase cruise power of the R-3350 turbo compound engines to 1,950 hp. in high blower and 2,000 hp. in low blower. This engine improvement is expected to increase cruise speed to 375 mph. and offer faster climb to cruising altitudes. These improved engines will be available for any new orders of the DC-7C.

Addition of synchrophasers on the 14-ft. diameter four-bladed Hamilton Standard propellers is expected to reduce the already extremely low cabin noise level.

BOAC Financial Loss Predicted

London—Financial difficulties within British Overseas Airways Corp., were revealed last week by the company's new chairman, Gerard Derlanger. In a statement read at a company staff meeting, Derlanger predicted the company will incur a loss of $4.2 million after interest paid during the present fiscal year ending March 1957.

The tone of the statement was in marked contrast to the annual report of ex-chairman Sir Miles Thomas only seven weeks ago. Thomas reported a profit of $4.9 million without the slightest indication of a possible loss in the future.

The company said however, that predictions of the financial future are not usual in its annual report.

On the same day of Derlanger's statement May 28, BOAC announced in effect, a pruning of its top staff in a reorganization. This appears to be in line with the financial outlook.

Derlanger's assessment was based partly on the report of a committee set up May 2 to examine aircraft requirements during the next ten years. It was reported that nearly half the deficit was expected because of the abnormal cost of introducing the Britannia into BOAC service. This entails non-revenue producing route-proving and crew training, and the burden of low utilizing rates expected during the plane's introductory period.

Another item is $2.1 million for wage raises, notably $1.1 million recently awarded pilots.

The introduction of DC-7C's will not reflect in the present financial year as they are not expected in service until the last period.

One of the personnel changes involves the retirement of operations director Sir Victor Tait. His post has been discontinued. Two new posts—chief of flight operations and chief of ground services—will report directly to the managing director. They will be filled with upgraded personnel.

Another new post—director of current operations—will be filled by H. Houchen, present deputy operations director.

Two other top positions—director of medical services and supplies manager—are due to become vacant soon.

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Capital Calls for Common-Stock Increase

By L. L. Doty

Washington—Capital Airlines has called a special meeting of its stockholders for June 22 to ask for an increase of capital stock from an authorized one million shares of common stock to 2.5 million.

According to the proxy statement, the company has under consideration the issuance of convertible subordinated debentures in the approximate amount of $12 million. The increase in capital stock to support the convertible debentures is necessary since only 90,441 shares of currently authorized stock remain unissued.

If the debentures are authorized by the board of directors, maturity probably would be in twenty years with an interest rate of between 4% and 5%. Net proceeds would be added to the company's working capital to finance the operation of new equipment over its new routes. There is no indication that funds would be applied directly to the purchase price of the 15 Bristol Britannias the airline expects to order (AW May 28, p. 44).

Should the debentures be issued, the company would enter into an agreement with underwriters for their sale. Underwriting conditions would be fixed according to market conditions at the time the offering is made. The debentures would be issued under an indenture with a trustee to be selected.

Conversion Plans

Capital estimates that between 300,000 and 375,000 shares of the proposed issue may be required as a reserve for future conversion of the debentures into common stock. The balance of the new stock will not be offered immediately but will be held for any future requirements of the company. Relative rights of Capital's stockholders will not be changed under the proposal.

This is one of the first signs that some airlines at least may turn to equity-type securities to finance transitional costs of moving into the jet age.

Braniff Airways recently obtained authorization to boost its common stock from two million to three million shares, although the company announced last week that the planned offering of additional stock to shareholders was being temporarily postponed. The airline originally had announced its intention of raising about $15 million through the sale of 1,105,545 additional shares.

American Airlines followed a similer pattern in 1946 when it financed a fleet of Convair 240's and Douglas DC-6's through the issuance of 3% debentures and 3.5% convertible preferred stock. Funds amounting to some $80 million enabled American to win a strong advantage by being the first to place post-war equipment in competition against converted C-54s and pre-war DC-3s.

Capital's entry into the turboprop field ahead of the rest of the industry places the airline in an enviable position. Thus far, however, the airline is financing its re-equipment program without the benefit of long-term loans.

Viscount Financing

The $71 million purchase of the Viscounts is covered by monthly installments over a period of five years at an interest rate of 1.75% in excess of the Bank of England rate in effect on the date of payment. Maximum interest charge is 6.25%.

United, American and Eastern Airlines have completed long-term loan arrangements with insurance companies for their jet programs. National, Braniff and others have reached satisfactory agreements for long-term loans with various banking groups.

Undoubtedly, however, some companies may be forced to seek additional means of raising capital to cover such transitional costs as training, parts and tools and revised maintenance and operations procedures. In addition to the sale of new securities, long-term loans may be supplemented by proceeds from the sale of equipment, retained earnings, fast depreciation charge-offs and short term loans.

A clue to the vastness of the financial programs ahead lies in a statement made last week by National Airlines' senior vice president, A. G. Hardy, to to House Anti-Trust Subcommittee. Hardy testified that National's capital expansion program of $100 million will result in a total investment "in 1960 roughly three times as great as in 1954. Net operating income required to provide National with 7% net income after taxes on such an investment will exceed $11 million."

Stanley Gewirtz, vice president of the Air Transport Association, has emphasized before the House Anti-Trust Subcommittee the importance of the airlines reaching an investment stature which would attract new money at favorable terms. He said that a substantial part of the $3 billion the airlines will require during the next ten years must be forthcoming through public financing.

An indication of the lack of appeal the airlines present to investors, according to Gewirtz, is found in the holdings of some 1,000 insurance companies and related fiduciary groups. Of the 12 domestic trunk lines, the common stock of only four airlines has found its way into these fiduciary portfolios.

In no case, he added, does the aggregate holdings of a single airline's common equity comprise more than 1% of the outstanding issue.

Examiner Warns Aero-Peninsular

Temporary suspension and a warning to operate under the law were penalties prescribed against Aero Finance Corp. and Peninsular Air Transport by a Civil Aeronautics Board examiner in the Aero-Peninsular Compliance Case.

CAB Examiner Edward T. Stodola found Aero and Peninsular guilty of combining operations and offering a regular service in violation of the Civil Aeronautics Act.

Sodola advises the Board to suspend Aero and Peninsular's operating authorities for 90 days and to order the carriers to cease and desist from violating the act in future operations.

The carriers have been guilty of three offenses, according to the examiner—operating with individual regularity, operating with regularity in combination with each other and operating with regularity in combination with each other and with a ticket agency.

Aero and Peninsular have operated largely between Miami and New York and Chicago, with occasional operations between Miami and Burbank and New York and Burbank.

The ticket agency associated with the two irregular carriers in the report was formerly known as Safeway Travel Service. In 1955, the agency changed its name to South East Airlines Agency.

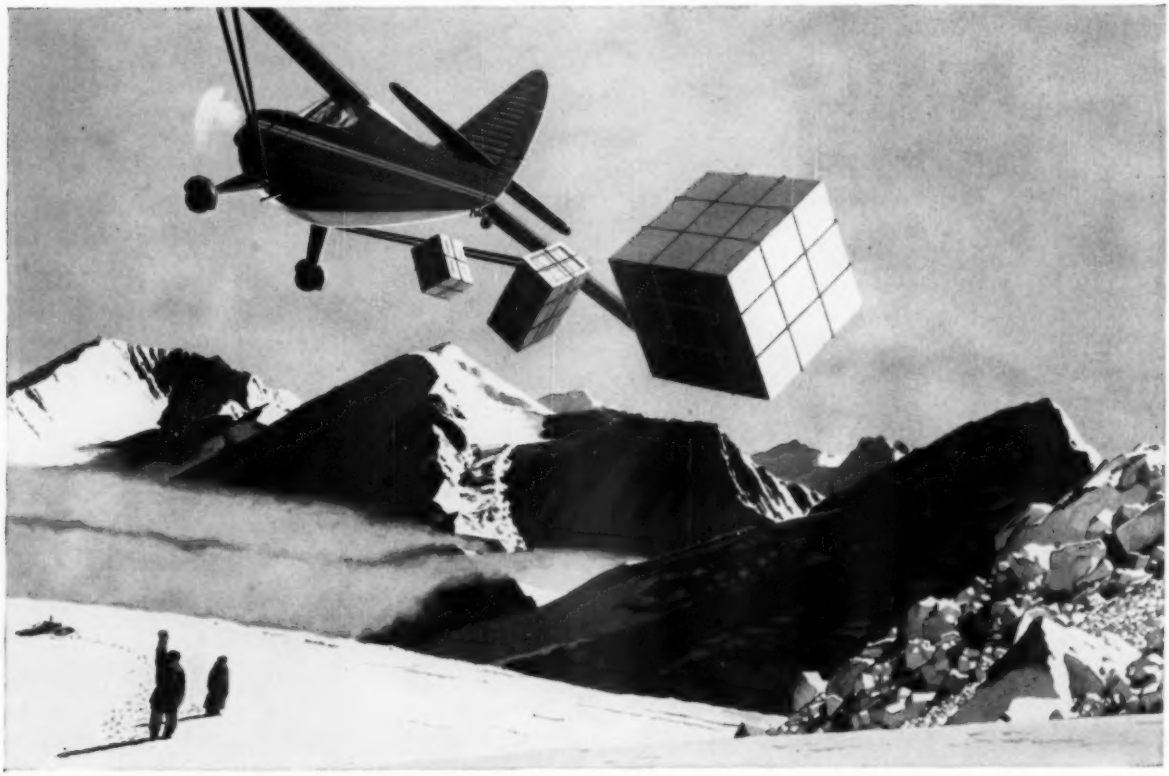
In recommending that the CAB punish the carriers with suspensions rather than revocation of their authority, Stodola pointed out that the Board recently has prescribed a new, more liberal set of rules for supplemental air carriers.

Stodola concludes that "Aero and PAT should be given one more opportunity to demonstrate good faith and capacity and willingness to operate in accordance with the provisions of the Act and the Board's regulations."

If they continue to operate unlawfully, the examiner recommends revocation of the operating authority of the guilty carrier.

PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA

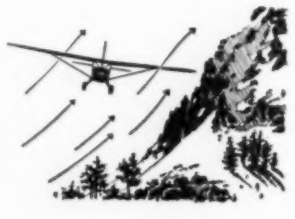


Delivering groceries to the Sierra crest

Snowbound in June! Every year from November to the first days of summer, a snow-survey engineer and his wife are isolated in their home high in the mountains south of Lake Tahoe. And each month Max Jones, a grocer of Gardnerville, Nevada, flies over the Sierra Nevada's crest to drop fresh vegetables, meat and mail into the soft snowdrifts piled near their door.

"Much of the trip is low-level flying," says Mr. Jones. "In spite of going over the top at 10,000 feet I don't have much room to spare. But even in a downdraft I get all the power I need with Chevron Aviation Gasoline 80/87 in our Stinson's Lycoming. Chevron 80/87 gives me performance to spare when I'm climbing, yet I can lean down for real economy in level flight. Burns clean, too; never fouls plugs.

"Flying over this kind of rugged wilderness calls for a really dependable engine. Ours has 500 hours on it now, and RPM Aviation Oils have kept it good as new. Compression is still up to factory standards. It's never missed a beat, always runs smooth as a watch. All the years I've flown, I've never had engine trouble using 'RPM'."



TIP OF THE MONTH

Downdrafts are often violent near the top of a mountain range. Mr. Jones advises flying on the windward side of any ridge or pinnacle; then you can turn upwind if you hit a pocket.

CHEVRON AVIATION GASOLINE

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T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

TEACHERS RECEIVING instructions before airlift. Note boarding in rear, deplaning forward.

Eastern Flights Teach Teachers

Baltimore, Md.—Eastern Airlines is making hay for the aviation industry as a whole with its "education airlift." Some 58,000 school people have been given rides on Eastern airliners along with lectures on the ramifications of the industry during the last two years. A good example of the smooth promotion program took place on a recent Saturday when 1,200 public school teachers were entertained at Baltimore's Friendship International Airport.

Eastern hasn't estimated the cost of the king-sized airlift, but one day's operation can tie up as many as three airplanes, along with relief crews, ground personnel and ground equipment. However, the airline is convinced that enough new business is being generated to more than cover the cost, not to mention the long-range value to Eastern and the industry in producing a horde of air-minded educators.

To indicate the scope of the untapped market for air transportation among this professional group alone, Eastern points out that 70% of the teachers it airlifts have never flown before. That adds up to 40,600 first riders who have had their initial flight experience under the program so far.

The teachers began arriving at Friendship around 8 A.M. under a tight schedule set up through their superintendent's office. During most of the day, two 404s were landing and taking off at 27-min. intervals, unloading 40 teachers from the front of a plane as 40 more streamed in from the rear.

At lunchtime, one of the aircraft took up a planeful of people invited by the school superintendent for filet mignon, courtesy of Eastern.

To handle this typical airlift, the airline used three crews, eight hostesses, and various ground employes including the local station manager.

When setting up a particular airlift, an Eastern representative visits the school superintendent of the selected city two to three weeks in advance. The invitation is extended, and lining up and delivering the teachers becomes the school system's responsibility. Any local press coverage also comes through the school rather than through Eastern.

Not that the airline discourages such publicity. It hits the local angle hard: e.g., two pilots whose hometown is Columbus, O., were pulled off duty elsewhere in the system to handle the Saturday airlift there. Some of their old teachers from public school days were photographed with the pilots, and both local papers gave the story a nice play.

But it is a "soft sell" operation as far as Eastern is concerned, with the emphasis on aviation rather than the airline in the brief pitch delivered to each group of teachers before they enplane.

At many locations, Eastern sends in spare parts—nose wheel, spark plugs, main gear assembly, and the like—a day or so ahead for speedy replacement during an airlift. In some cases loading steps have been trucked in from other stations to handle the airlift.

Of the public school teachers who have been offered an airlift ride, about 80% have accepted. In parochial schools the acceptance rate has been about 95%.

CAB ORDERS

(May 17-23)

GRANTED:

William S. Munz an exemption to operate Alaskan routes certificated to Howard J. Mays pending a CAB decision on an application to transfer Mays' operating authority to Munz.

Trans World Airlines permission to buy eight Lockheed 1049G and 25 Lockheed 1649A aircraft from Hughes Tool Co.

Trans-Pacific Airlines an exemption to lease a DC-3 aircraft from Harry H. Hill, Jr., until June 30, 1957.

Slick Airways permission to serve Washington through Washington National Airport and/or Friendship International Airport.

Flying Tiger Line's petition for reconsideration of earlier CAB action denying an exemption to perform transatlantic charter flights for the Wayne University Travel Study Plan, Boston University Summer Travel Courses and San Francisco State College, an exemption to perform a transatlantic charter flight for Temple University also was granted.

APPROVED:

Agreements between Northern Consolidated Airlines, Wien Alaska Airlines and Westair Transport involving the lease of certain C-46 aircraft by NCA and Wien for use on military contracts. Westair was granted an exemption to provide the services involved.

New York Airways' flight pattern revision which adds passenger service on one-way mail and cargo flights between LaGuardia Airport and Stamford, Conn., daily except Saturday, Sunday and holidays.

Interlocking relationships between C. H. Price, D. J. Martin, Trans World Airlines and Hughes Tool Co.

Agreements between various carriers adopted by the International Air Transport Assn. relating to the government excess-baggage authorization form.

ORDERED:

Ozark Air Lines to show cause why the Board should not set temporary mail rates of $2,023,886 for the period April 15, 1955, to Mar. 31, 1956, and 53.47 cents a mile for the period starting April 1, 1956.

Bonanza Air Lines to show cause why the Board should not set mail rates of $898,429 for the period April 25, 1955, to Jan. 31, 1956, and a sliding scale rate formula based on an annual rate of $1,308,578 for the period starting Feb. 1, 1956.

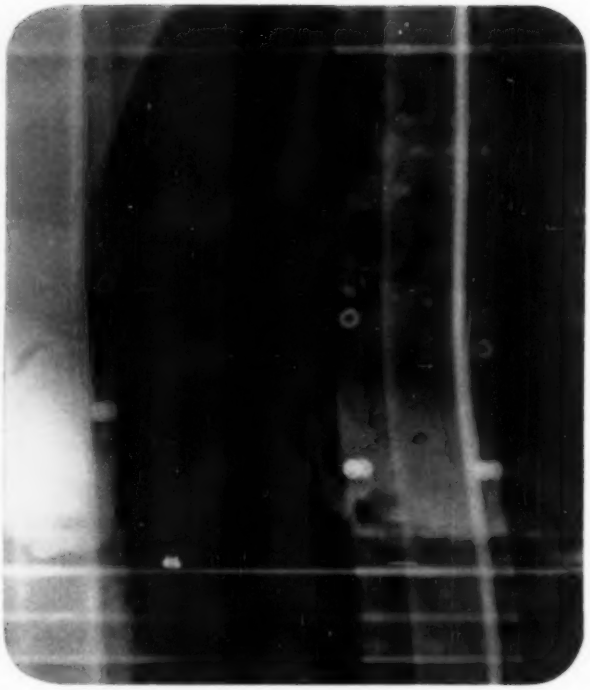
Applications filed by Braniff Airways, Delta Air Lines, National Airlines, North American Airlines, Trans World Airlines, City of Nashville and City of St. Louis consolidated with the St. Louis-Southeast Service Case. Any new services authorized in the case which operate to the Southeast from points beyond St. Louis will be required to stop at St. Louis.

Shortlines

► **Air India International** will accept delivery this month on the first of three Super-G Constellations on order. The new transport will be used on routes to Great Britain.

► **Allegheny Airlines** is using 15 Air France hostesses on its system this summer under a six-month program it has

Removal and replacement of sealed caps and sealing compound used to take National 24 hours. Now their radiographs are ready for viewing in 60 minutes.



Radiograph showing pressure seal on National Airlines' DC-7 where wing stringer enters fuselage.

a 24-hour job... now takes 1 hour with Radiography

Among the thousands of spots National Airlines regularly safety-checks on its planes are the pressure seals where wing stringers enter the fuselage. It used to mean a 24-hour job—until radiography took over. Now it takes an hour.

This shows again the importance of radiography in making inspections, whether of assemblies, welds or castings. It can save time—can save money—can build suppliers' reputations for producing and delivering only sound work.

If you would like to know how radiography can improve your operations—call your x-ray dealer. He'll be glad to talk it over with you.

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entitled Project Lafayette. The project is designed to promote foreign travel from Allegheny's service area and create better understanding of American travelers by foreign airline flight personnel.

▶ **Avianca**, the Colombian airline, has signed an interline agreement with Scandinavian Airlines System to carry SAS passengers between New York and Colombia.

▶ **Braniff Airways** will use Acroproducts propellers on the Allison 501 engines specified for the carrier's order of nine Lockheed Electras.

▶ **KLM Royal Dutch Airlines** will inaugurate service to Budapest, Hungary, and Sofia, Bulgaria, this month with a weekly DC-6 service from Amsterdam. . . . KLM has ordered four-bladed Hamilton Standard hydromatic propellers for its Lockheed Electras.

▶ **Middle East Airlines** began Viscount service to Paris and London last month with two flights a week. The carrier also has added an Athens-Vienna-Zurich route and a direct service to Rome.

▶ **North Central Airlines** reports that traffic for the first five months of the year is approximately 56% above the same period last year. . . . North Central has started its summer service to Land O'Lakes, Wis., with four flights daily.

▶ **Northwest Airlines** has signed a new 28-month agreement with the Brotherhood of Railway and Steamship Clerks.

▶ **Ozark Air Lines** carried 65,826 passengers during the first quarter of the year, 59.4% more than in the first three months of 1955.

▶ **Pan American World Airways** has added a fifth weekly round-the-world flight. The flight connects with transatlantic schedules at London and flies to Los Angeles via Frankfurt, Istanbul, Ankara, Teheran, Karachi, Bangkok, Hong Kong, Wake Island and Honolulu. . . . Pan American has asked Venezuela for permission to establish tourist fares between Caracas and New York.

▶ **Riddle Airlines** flew 2,798,414 lb. of freight in April, an increase of 58% over the previous April.

▶ **Sabena Belgian World Airlines** will offer eight tours to Russia this summer. The tours, arranged through agreements with Aeroflot, the Russian airline, and the USSR Intourist Travel Bureau, range from $1,595 to $1,890 and from 11 days to 31 days.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

Standards for New Instruments

A sure way to start an argument is to bring up the subject of instrument panels. Seems as if everyone in aviation is certain that his ideas are the best. This leaves us with several hundred "best" arrangements.

Some years ago the SAE appointed its now famous Committee 7 to bring order to this chaos by developing a standard grouping. Their fine recommendations were accepted by most of aviation and gradually some of their ideas have crept into the cockpit.

Naturally, the SAE people designed their layouts—four of them—around instruments which were available at the time of their deliberations. But, like all branches of aviation, progress marches on in the science of instruments.

We now find numerous combination, or integrated, instruments on the market while the standard provides for the old-fashioned ones. And here we go again!

Second Rate Method

Of course the newer gages can be used in the old layout. But this is a second rate method and does not make fullest use of some of the desirable features of these combination instruments. In view of the fact that faster aircraft are soon to be introduced to our transport fleet, and each year sees the need for more precise flying, it does not make good sense to lose even a small part of the advantages of modern design.

In an effort to secure the maximum benefits from the newest instruments several groups of airline pilots have firmed their desires on a single design. (AW March 26, p. 92). Basically we might call this arrangement a cross-hair system. That is, the most essential flight instruments are placed in the top row for horizontal scanning—just as the pilot visualizes the attitude of his aircraft.

Navigation data is positioned directly in front of the pilot in a vertical line just as he visualizes his flight path.

Pilots Recommend Layout

Pilot committees from American, Braniff, Eastern and National, to mention but a few, have recommended this layout for their Boeing 707's, Douglas DC-8's and Lockheed Electra's. But present standards do not allow this exact layout and neither the manufacturers nor the airlines involved wish to disregard the existing laws. At the same time nobody wants to produce an aircraft panel which the pilots don't like or which does not permit maximum effective flight.

Effective is a big word in this discussion. These new aircraft will have to be flown effectively—to lower minimums and on more precise tracks—if they are to produce the expected return for their cost. And equally obvious is the fact that the entire airplane is tacked on to the flight instruments; they lead, the plane follows.

Speed also is important here. Everyone is anxious to put the new aircraft into the air at the earliest possible date. Orders for these new ships have come so fast, and delivery is so close, that it has been impossible to go through the usual exhaustive, two year committee studies on every item. Instrumentation is just one item—but a most important one—on which rapid action is needed.

The ALPA has already petitioned the CAB for permission to use the new combination instruments in accordance with pilot wishes. Pilots would like to see standardized panels. But there is also a strong feeling that new aircraft and new instruments should not be retarded because of old standards.

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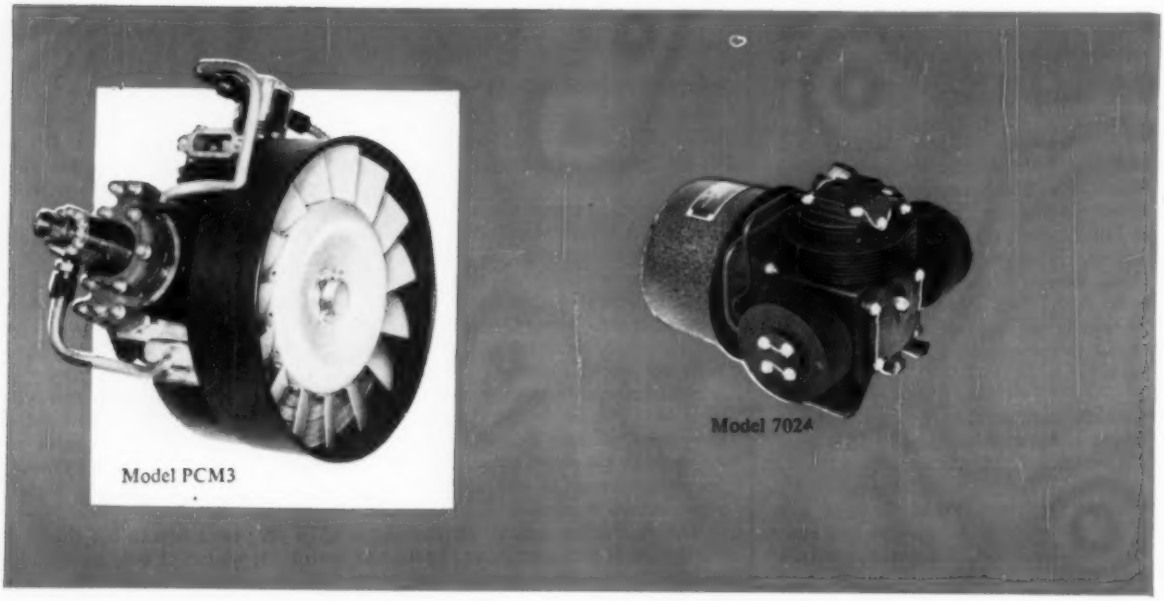

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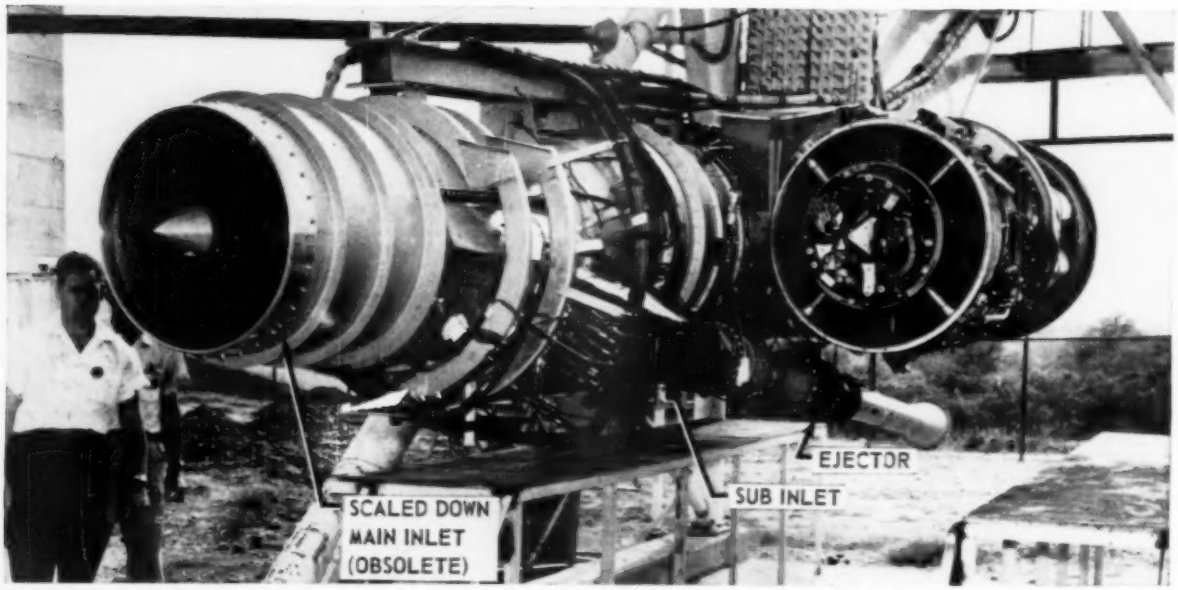


DOUBLE PODS for B-58 powerplants were obsoleted by area rule, would have imposed severe wing heating problems.

B-58 Foreshadows Mach 2 Powerplant

By David A. Anderton

The pattern for one type of powerplant installation in the next generation of Mach 2 aircraft has been set by the four podded units of Convair's B-58 Hustler weapons system.

Features of the podded powerplants include:

- **Variable geometry** of the inlet, automatically controlled to maintain maximum efficiency.
- **Sub-air systems**, handling the tremendous volume of flow to cool and ventilate the airplane and its accessories systems.
- **Consideration of the thermodynamics** of the installation as a system, rather than as a number of separate additive and subtractive items.

Hustler Description

The B-58 is a weapons system, not simply an airplane. Its primary role is that of a strategic bomber with nuclear capability at delivery speeds of Mach 2.

Consideration of the design for other roles—notably as an entry in the long-range interceptor program—hints at the versatility of its concept, with weapons and weapons carrier designed as integral parts of an aerial delivery system.

Powerplant is a quartette of General Electric J79 turbojets, podded individually. Basic considerations of the area rule application to the Convair F-102A suggested a similar look at the B-58. The result was that the four pods are used to fill in the area diagram to approach an ideal distribution. The final layout is an unusual one.

General characteristics of a typical podded turbojet for a Mach 2 airplane were spelled out two years ago (AW, July 12, 1954, p. 28); the Convair B-58 pods follow the basic scheme described then.

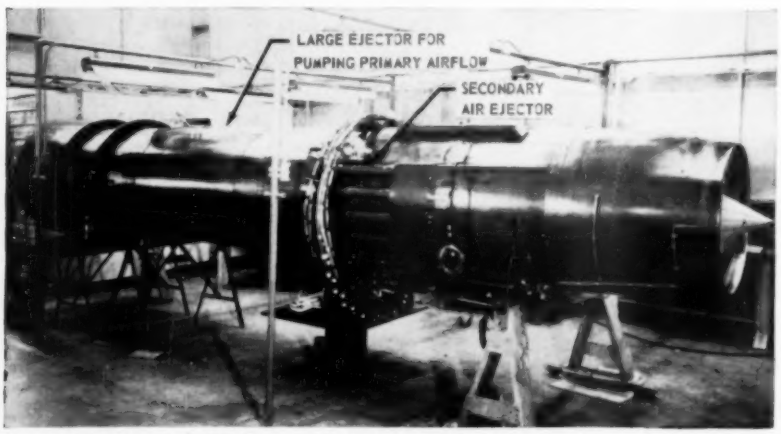
The basic problem is that the installed weight of the engines plus fuel is a governing design factor in supersonic airplanes; the weight of the complete powerplant may be as much as two-thirds of the gross weight of the airplane.

Fuel Plus Engines

The volume of fuel plus engines is the biggest factor in determining the overall drag of the airplane. Anything done to minimize the drags of the engines and the fuel is a step in the right direction.

Almost all of the problems in developing maximum thrust for minimum installed weight and size stem from the air-breathing characteristics of the engine.

The key to supersonic airplane performance lies in the inlet to the engine. Compressor stall, its stall limits, early flameouts and even structural failures of the compressor blading or inlet duct



BASIC LAYOUT of the B-58 powerplant without the sub-inlet systems.

can be traced to poor inlets.

Convair engineers, with these warning signs in mind, made early studies of the inlet system and arrived at a final choice. A B-58 pod has a multiple-shock inlet, with variable geometry automatically controlled.

The design compromises were built around a single point:

> Maximum value for the difference between thrust and drag at both subsonic and supersonic speeds.

Eight wind tunnels and several hundred test hours were used in developing the final inlet system configuration. Plots of the distribution at the engine face for many flight conditions were sent to General Electric for simulated mal-distribution runs to check J79 performance.

Secondary Air

Ram air, taken through a number of sub-inlets located downstream of the main inlet for the powerplant, is used to cool the engine oil, the hydraulic fluid and the compressor bleed used for cabin conditioning.

Three ram-air coolers are used. The coolant air, after flowing through these, passes on downstream over the engine and the accessories to help reduce the local temperatures and is exhausted at the rear of the nacelle.

For flight speeds below Mach 0.6 and all ground operations, a cooling door is opened in the side of the nacelle because the normal pumping action at the secondary air exhaust is not great enough to overcome the negative pressures of the inlet duct. Some of the air entering through the cooling door flows in reverse through the coolers, and the rest of it follows the normal downstream path over the engine and accessories.

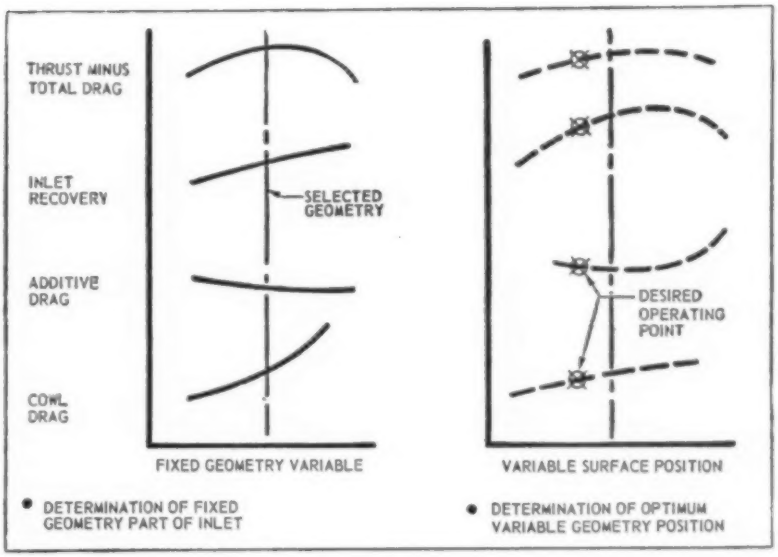
The sub-inlets were developed under a separate wind tunnel program because the original models for the main inlet had the wrong boundary layer conditions.

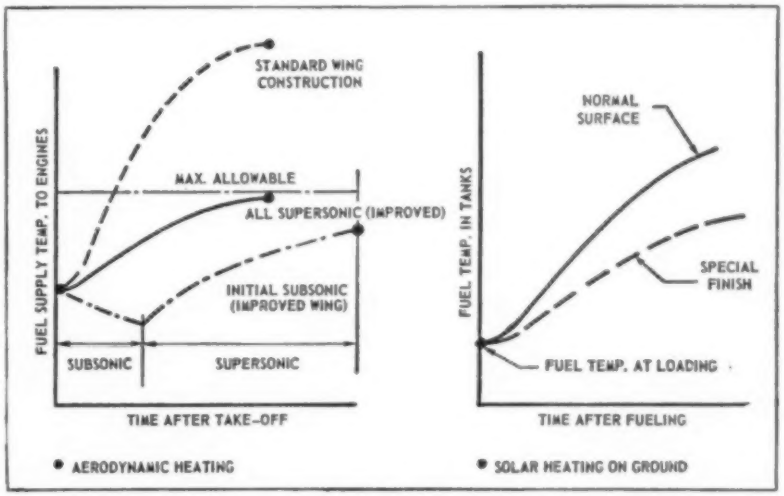
The engine oil cooler provided the toughest problem in the sub-inlet systems.

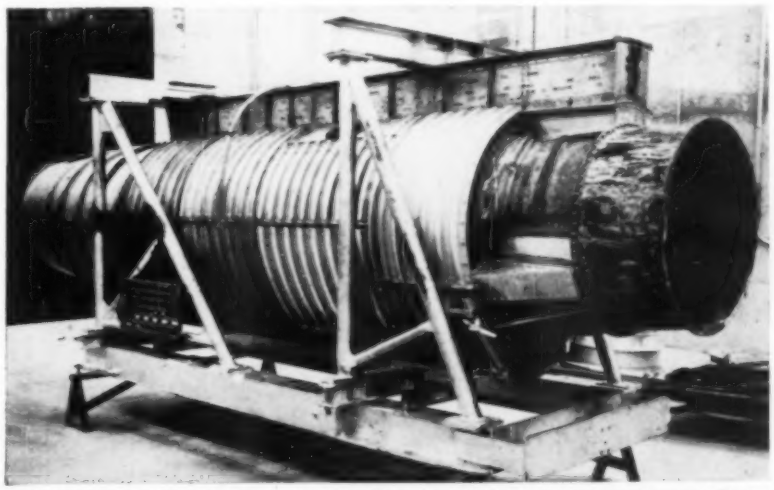
The length available for the duct was very short, and the throat of the duct had to choke to throttle the flow at some flight conditions and operate very close to choking at others. Final configuration was established, after a separate test of a wooden model of the duct, with the cooler tilted instead of being normal to the flow.

Thermodynamic System

Engine and aerodynamic heating pose severe problems for designers of supersonic aircraft. Convair's B-58 was one of the first designs where the thermodynamics of the entire airplane was considered as a system, instead of







B-58 NACELLE ready for test in free-jet cell at Arnold Engineering Development Center of ARDC. Egg-shaped cross-section is necessary to handle sub-inlet flows for secondary air systems of the Hustler supersonic bomber.

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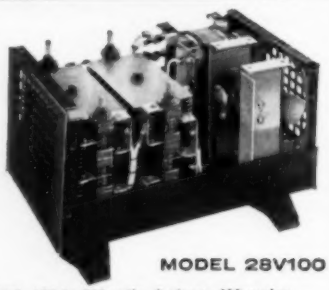

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being tackled piece by warm piece.

One of the first heating problems arose in early considerations of engine mounting. With a delta-winged layout, the four pods would be placed ahead of a rather long wing chord. Convair engineers believed that the wing heating from the jet exhaust would be a critical condition.

Their studies showed there really was no flight problem, but on the ground heating would be critical. Tests were set up using a General Electric J47 engine to simulate the hot exhaust. The siamesed pod with twin engines installed heated the wing to a temperature that posed a serious structural challenge.

But area rule applications dictated separation of the engines. Even though the wing heating problem was lessened by the choice of pod geometry, it could have been further aggravated by the nacelle incidence needed for optimum inlet recovery during cruise conditions. The compromise was made between optimum incidence and wing heating.

Heat Increased

The current use of thin wings necessary to hurdle the sonic fence means that there is a high ratio of surface area to internal volume. This increases the amount of aerodynamically generated heat transferred to the fuel during flight.

Convair structures designers developed a type of wing construction which had fair insulating properties and, in addition, was lighter and stronger than conventional wing construction. Other studies developed these flight and ground handling techniques to reduce the effects of heat transfer during a typical mission:

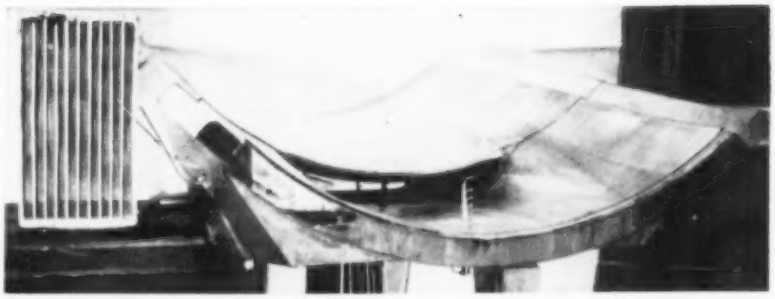
- **Subsonic cruise** for a short time before the supersonic dash to the target and return to subsonic cruise sooner than otherwise.
- **Use of a special finish** to reflect more solar radiation while the plane is on the ground.
- **Mission planning** so that loaded airplanes don't sit in the sun before all-supersonic flight.
- **Use of insulating covers** to protect the wings on the ground.
- **Ground refrigeration.**

Several heat transfer specialists were assigned to full-time study of the B-58 thermodynamics.

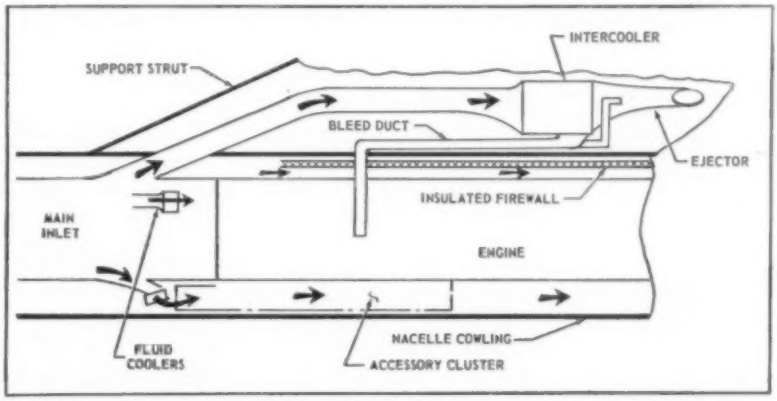
Data they supplied was used as a basis for selecting lubricants, materials and allowable stresses.

No Firewalls

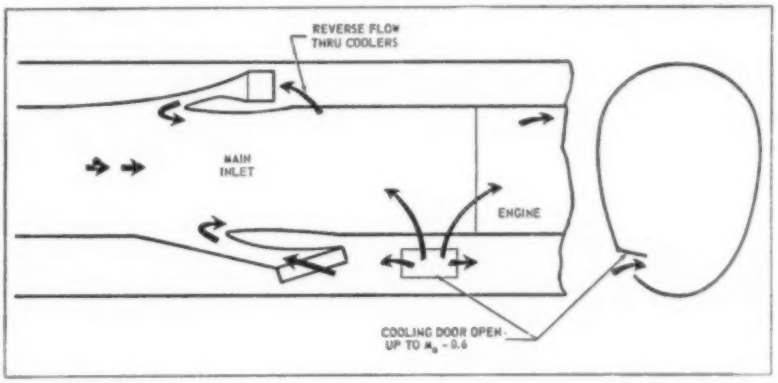
The conventional firewall aft of the compressor station has been replaced by a lot of airflow straight through the space between the engine and cowling. Studies of the compressor case and



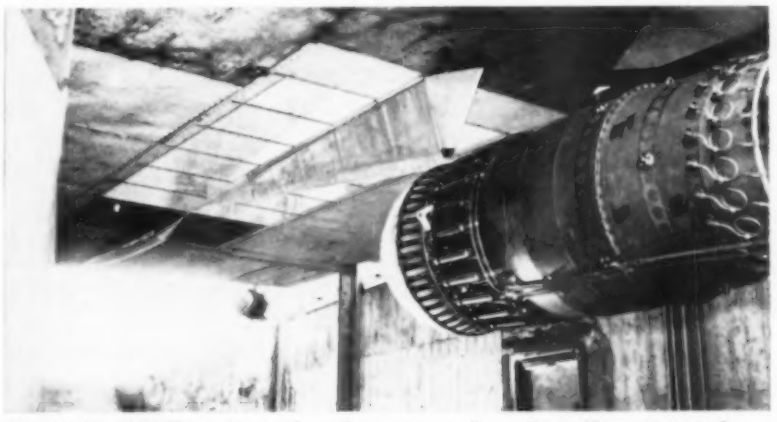
SEPARATE wind tunnel program used wood model of sub-inlet to establish configuration.



INTERNAL arrangement and secondary airflow system in high-speed flight is shown.



NEGATIVE duct pressure level on ground and at low speed make cooling door necessary.



JET BLAST EFFECT, varying with pod geometry and nacelle incidence, is tested.

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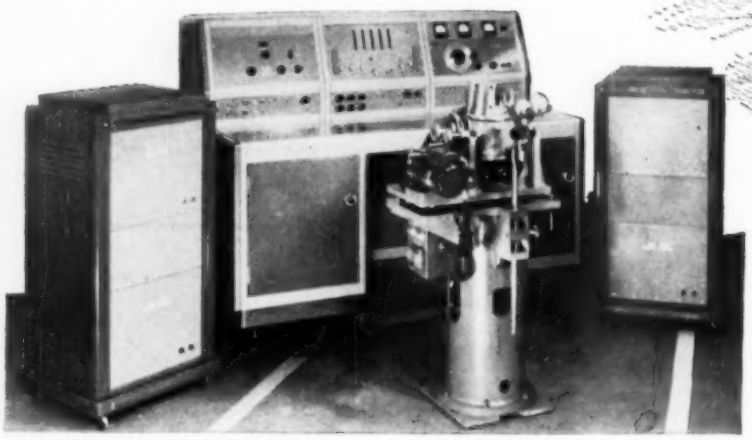

Greenleaf Manufacturing Company, as a producer of Integrating Gyros, realized the need for a Dynamic Integrating Gyro Servo Test Table. This Test Table was designed and developed to facilitate the evaluation of Integrating Gyros, and Greenleaf now makes this valuable test unit available to industry.

The Gyro Servo Test Table can measure the following characteristics:

1. The drift rate of the gyro unit.
2. The current product angular velocity sensitivity ratio.
3. The characteristic time.
4. The angular velocity input voltage rate output sensitivity.
5. Minimum rate detectable.
6. High limit angular velocity deviation of performance.
7. Low limit angular velocity deviation.
8. Signal generator linearity.
9. Torque generator linearity.

Since a time interval meter is incorporated in the system, the following data can also be obtained:

10. Spin motor excitation frequency.
11. Spin motor excitation voltage
12. Spin motor excitation current.
13. Signal generator excitation current.
14. Signal generator null output voltage.

In addition the following tests can be made:

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bleed manifold temperatures showed them to be almost as high as the "hot" end of the engine, and in any case, in excess of those required to give spontaneous ignition.

There is a firewall separating each nacelle from its support strut to keep any engine fire from spreading to the wing.

Fire curtains also will be installed to separate the strut from the wing. The strut is to be ventilated and the firewall insulated to keep fuel from igniting should it drop down onto the firewall.

Convair Studies

The B-58's electrical and hydraulic systems are driven directly off the engine drive pads rather than using a separate auxiliary power unit. Convair studies indicated there was appreciably less performance penalty doing this providing the frontal area increase could be kept to a minimum.

One layout considered was an in-line arrangement of the accessories, with the aircraft hydraulic pump in the drag shadow of other engine accessories.

Convair has been running an extensive test program of the B-58 powerplant on the ground and in simulated flight.

Tests have been made with a built-up complete powerplant in the Engine Test Facility of the Arnold Engineering Development Center of the Air Research and Development Command.

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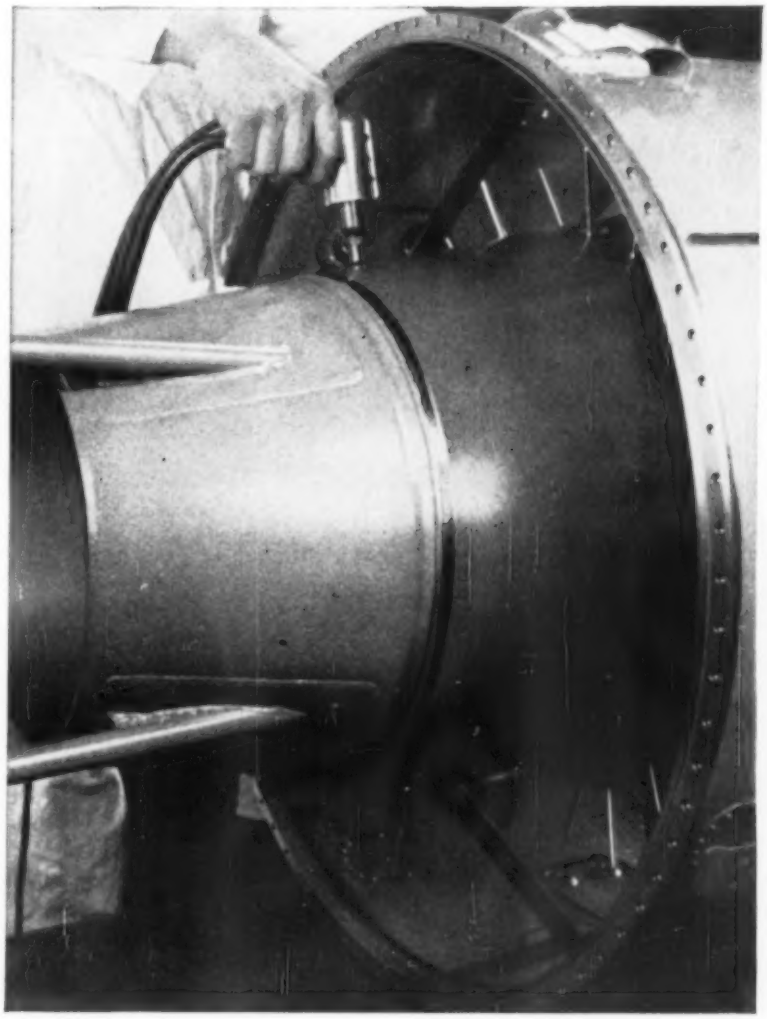

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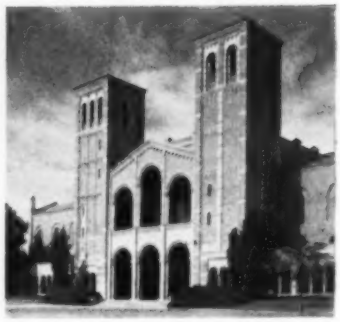

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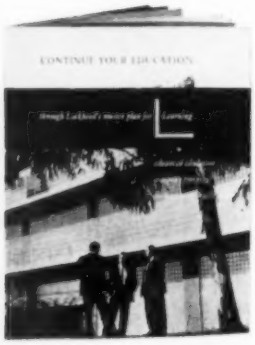

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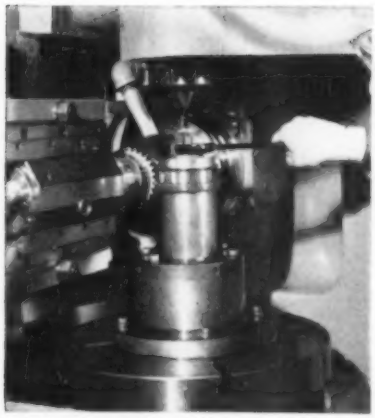

"ULTRACISION" HOBBER was built by Barber-Colman to Sperry requirements for gears accurate to ten seconds of arc. Sperry engineer Charles Aldino looks for burr formations with a low-power magnifier. Fixture clamping plate is loosened to remove the cut gear.

Sperry Invests $500,000 In Hunt For Most Accurate Gear Ever Cut

Sperry Gyroscope Co. is trading half a million dollars for 10 seconds, the expected angular error in sets of new stainless-steel gears planned to be the most accurate ever cut.

Needed for gear trains in control systems for missiles, aircraft and radar, the gears are to be cut on a special "Ultracision" hobber built by Barber-Colman from Sperry specifications. One unusual feature: Sperry assumed the responsibility to check the machine during its construction, and Barber-Colman guaranteed not the machine, but its final product.

The hobber was built in about a year and one-half from contract to delivery.

Angular Error

Sperry's requirements were for gears of about four-inch diameter which had to have non-adjacent tooth spacing accurate to 10 seconds or less of angle at any point and on any diameter along the tooth profile.

Gears like that hadn't been made. Sperry's own manufacturing equipment was at the upper limits of its accuracy, and a survey of more than 100 vendors here and in Europe showed there wasn't much hope for better gears on a production basis. There was no demand, and that meant no interest.

Sperry took over, built its own isolated manufacturing research laboratory and started to investigate the problem. New measuring equipment, new holding devices and gages would be required.

With some backlog of understanding of the gear-cutting problem, Sperry resurveyed machine tool makers. Barber-Colman was the only vendor willing to attempt to meet the requirements.

The result was a new kind of precision gear hobber, mounted on a separate concrete block to insulate it from the rest of the building. The first experimental gears have been cut at Sperry and although they don't quite make the tolerances, there is every indication that these early manufacturing difficulties will be cleared up.

Some Problems

Materials hardness is one area where improvement in control of the supplied batch is necessary. Steel suppliers indicate that they may be able to furnish certified stock of a guaranteed hardness, with a nearly homogenous composition.

Centering of the blank to be cut is another problem. It is too time-consuming. There is a real need for a fast system accurate to about one-millionth.

Hob cleaning is another stumbling block. Cutting fluid and air blast don't complete the job. A soft brush will leave enough of a deposit to drop the accuracy; a hard brush will scratch the tooth surfaces.

De-burring is a third problem. Brushing is out, and mechanical means are too inaccurate. One possibility: An electrical-discharge de-burrer, using a tool which never touches the work.

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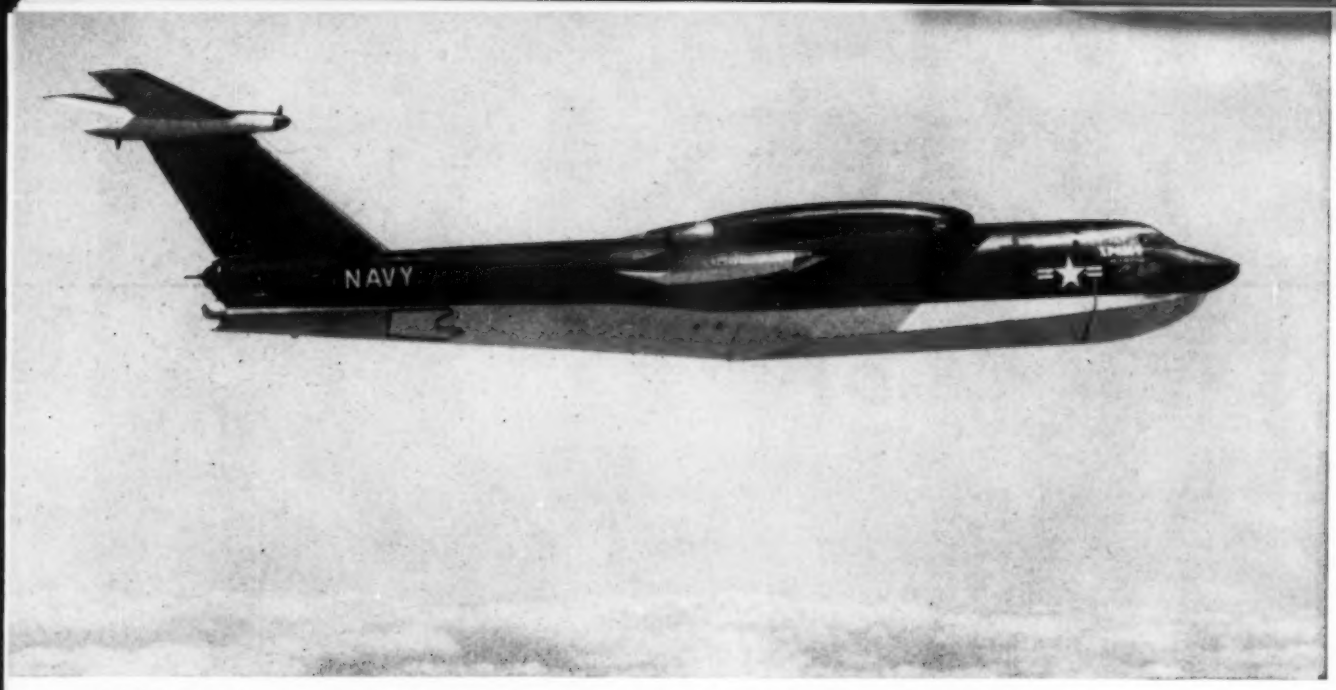


CRUISING ON TOP, model shows lines in new white hull paint of rotary mine door (forward), and hydroflaps (aft).

Second XP6M-1 SeaMaster Begins Tests

1. **SECOND MODEL,** in taxi tests, met 2 to 3 ft. waves, but rode easily as first model did when this picture was made.

3. **SPRAY LESSENS** as hull of the first SeaMaster breaks water. This model of 600-mph. multi-jet is single color, not two-tone.

EXHAUST TRAILS as successor to model that crashed Dec. 7 takes off from Chesapeake Bay for 1 hr. 25 min. flight

With Same Configuration, Different Colors

2. **NOSE OF FIRST MODEL** rises as seaplane is lifted on "step." Test boom on nose does not appear in pictures of new plane.

4. **AIRBORNE,** first model does not display lines for hydroflaps, used for water rudder or brakes, or mine door.

GE Bids for Helicopter Market With T58

By Robert H. Cushman

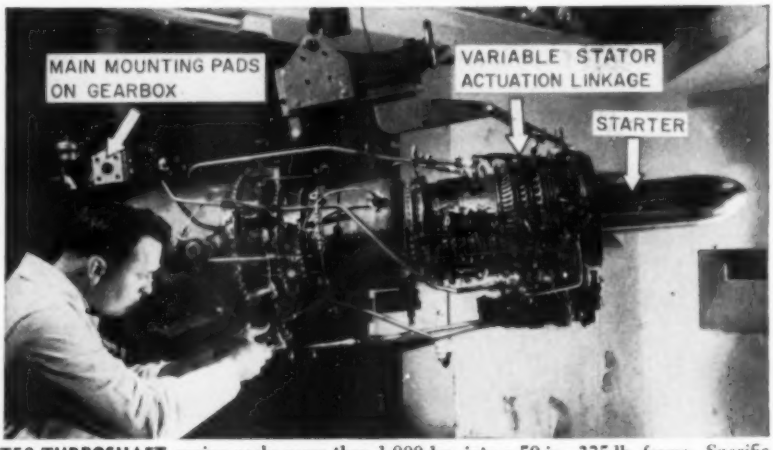
The T58 engine is General Electric's entry in the promising helicopter powerplant market. The 1,000 hp. turboshaft is scheduled to finish qualification tests and undergo tie-down and flight tests in the Sikorsky S-58 in the near future.

Although the T58 has been financed by the Navy, GE hopes to expand its sales beyond military helicopters. The company is thinking of the T58 in various modified versions for turboprops and jet aircraft.

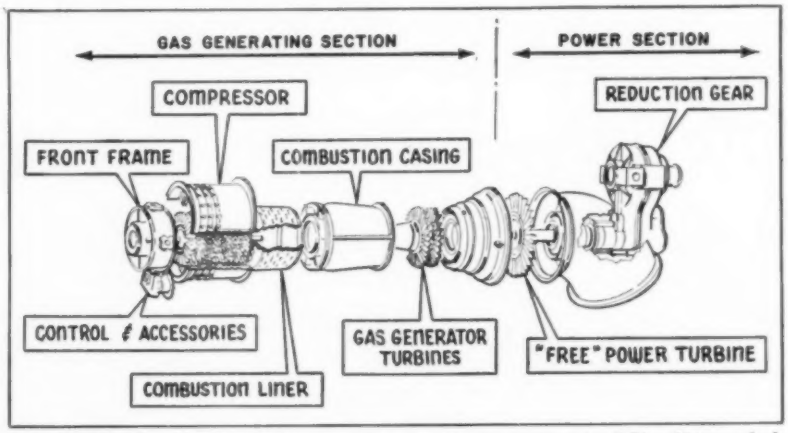
The small shaft turbine is the result of GE's Small Engine Department, Lynn, Mass., attempt to come up with a powerplant which would be:

- **Much better** for helicopters than present piston engines.
- **Attractive to** helicopter designers and operators in competition with other engine manufacturers' new designs.

GE realizes that to be better for helicopters than a reciprocating engine, its gas turbine must capitalize on its theoretical ability to increase a helicopter's performance through more power for less weight and size. At the same time the actual hardware product must not be too susceptible to its own weaknesses, high fuel consumption and a relatively new type of transmission.



T58 TURBOSHAFT engine packs more than 1,000 hp. into a 59-in., 325-lb. frame. Specific fuel consumption is 0.69 at normal rating.



SCHEMATIC drawing shows flow arrangement of components in T58. Sixteen fuel nozzles (1 on each of two manifolds) are mounted on front of combustor's inner liner.

A Lightweight Engine

GE designers have attacked the fuel consumption obstacle by choosing a moderately high compression ratio. Then, to retain basic reliability and long life, they backed away and chose a moderate turbine inlet temperature. Around these two primary design decisions the Small Engine Department has produced a remarkably lightweight engine.

The T58 not only cashes in on the scale effect inherent in small size (as engines get smaller weight drops off faster than thrust) but GE designers have given it the benefit of what Harold Hokanson, project manager, calls "mechanical design sophistication."

The resulting basic engine, less reduction gearing, combines a .69 sfc with a specific weight of .24 lb. per hp. It matches a piston engine's sfc in "major areas of helicopter operation." But it remains to be seen how much more it will cost. The T58 will not be a cheap engine.

The T58 uses a free turbine or gas-connected powerlink between its gas generating section and the output shaft. The two turbines fixed to the end of the compressor shaft develop only enough power to turn the compressor. Downstream is a third, free turbine on its own shaft which absorbs the left-over gas energy and feeds it into the output gearing.

The free turbine drive, at the expense of an elaborate control system, allows the gas generating system to operate independently at its own speed while the free power turbine rotates within the narrow rpm. limits typical for helicopter rotors.

Constant Rotor Speed

Helicopter operation demands constant rotor speed despite sudden loads. For example, when the pilot suddenly has to increase the rotor pitch to climb his 'copter up and out of a tight spot the rotor speed must not fall off and stall the blades. Backers of the free turbine drive point out that if the free turbine's rpm. is snubbed down by the rotor the free turbine will bite in and pull more power out of the gases.

This inverse relationship between free turbine speed and power for a constant gas energy is in itself stabilizing, but for full compensation the control loop must operate to sense the speed fall-off and speed up the gas generating section. Since the gas generator's rpm. is independent of the output rpm. the compressor-turbines of the gas generator can more readily respond to the increased fuel flow and send more gas energy back to the power turbine.

Advocates of free turbine say the fixed turbine drive under these same conditions will find its efforts to respond to corrective control and extra power seriously curtailed because it is saddled with the adverse effects of the helicopter's rotor.

Not Unanimous

As yet the helicopter industry is not entirely sold on free turbine drives. For high forward speed helicopters, the fixed turbine is superior, argues Ralph Alex, senior product design engineer,

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This new weapons concept is the result of Navy steam catapult capability, a launching cart developed by Chance Vought and the remarkable reliability of *Regulus*, first operational attack missile to serve with the fleet.

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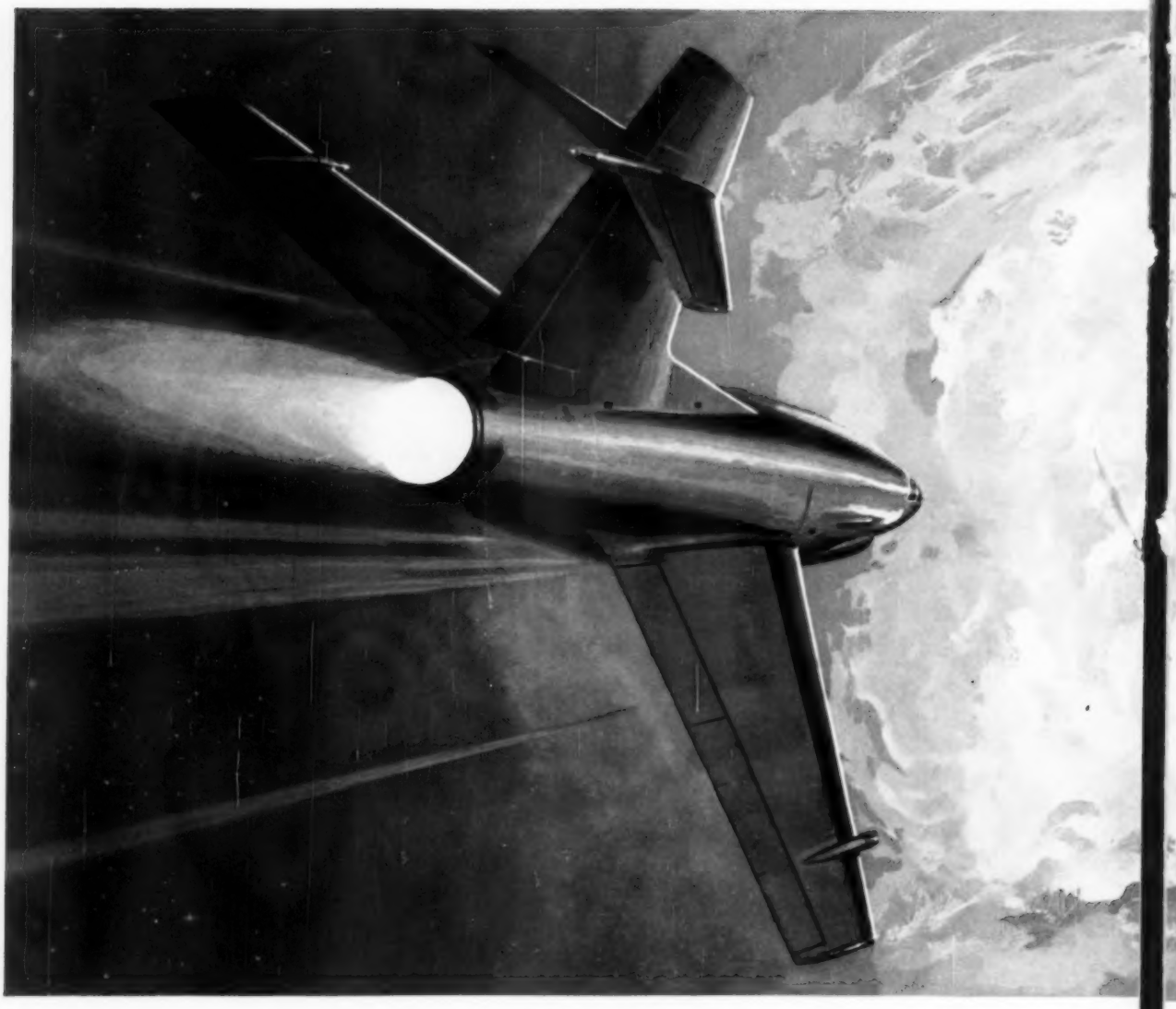


At Today's Supersonic Speeds—"skin friction" causes blistering temperatures to build up within jet aircraft. Here's what Goodyear is doing about the problem

IN smashing the sound barrier, airmen and aeronautical engineers have encountered yet another:

The Heat Barrier.

Today it represents the most formidable foe of aviation progress.

For at blistering speeds, blistering temperatures build up.

It is the result of "skin friction"—caused by the rush of air rubbing against an aircraft as it cleaves its way through the sky at speeds twice that of sound, 1,500 miles per hour and faster.

Goodyear is devoting extensive research to high-temperature problems and high-temperature materials.

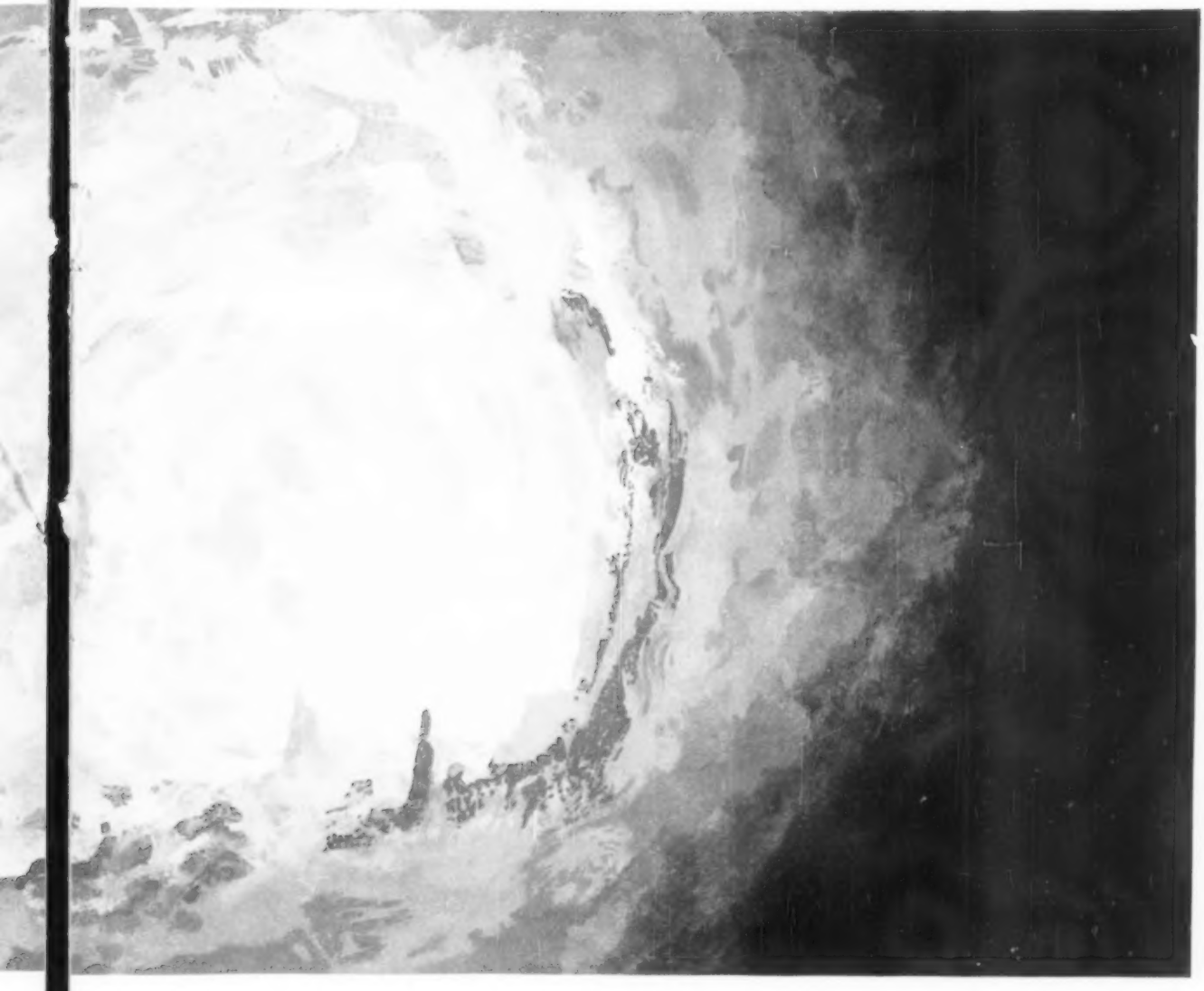
For within the high-speed aircraft of tomorrow, if they are to achieve their calculated speeds — temperatures will soar to *500° F. and beyond.*

Under such heats, present aircraft structural materials tend to disintegrate—to lose strength at an alarming rate, become totally inadequate.

In this research, Goodyear is notably well equipped.

It has pioneered new alloys, new materials for aircraft wheels and brakes—a place where high temperatures have long been a major engineering hurdle.

It has discovered ways of building in "heat sinks" to store heat until it can be dissipated—well typified by the recent development of the Tri-Metallic aircraft brake.



# of Hades in the Heavens

It has developed, for guided missiles, new inorganic compounds — materials which withstand devastating heats, yet have many of the desired qualities of existing organic materials.

It has explored the realm of new "synthetic" elements, experimented with fluorinated additives, silicones and polymer coatings—studied their performance on the "Rim of Fire and Brimstone."

Today, this high-temperature research for Goodyear's Aviation Products Division continues — with the full backing of Goodyear resources, facilities and skill.

Many of these problems are far from solved, but progress is being made—progress which will be helpful to the aircraft industry in keeping America first in the air. Goodyear, Aviation Products Division, Akron 16, Ohio, and Los Angeles 54, California.

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Sikorsky, reaffirmed his views (AW Feb. 22, 1954, p. 22). Because the fixed turbine is lighter and can quickly resist sudden rotor speed variation with the added inertia of the compressor, it really is better equipped to supply the precise constant rotor speed imperative in modern high speed helicopters.

The free turbine is used to best advantage, Alex says, in multi-engined helicopters which might want to hover near sea-level at sea power for considerable lengths of time. Because the individual gas generating systems of multi-engined installations are not rigidly geared into the common rotor they can adjust their operating speeds to equally divide up the workload.

A free turbine can operate at cheaper fuel consumption during part power demand.

Its compressor can slow down to its own speed. It can, in effect, become a smaller engine cutting down the flow through the compressor to suit the lower demand. Even though the power demand on a fixed turbine is cut down, the compressor still must be maintained at the given helicopter rotor speed. It cannot slow down to match the reduced fuel flow.

Engine Details

As can be seen in the accompanying illustrations, the T58 is composed of a gas generating section followed by a power conversion in which the free power turbine takes the gas energy and converts it into shaft horsepower at 24,000 rpm. This is geared down to 240 rpm. in the S58 in two steps: 5:1 by GE at the rear of the engine, and the rest by Sikorsky in the transmission.

The gas generating section has the usual gas turbine sequence, a compressor, a combustor and a compressor drive turbine. The power section is a single stage turbine. Downstream of the power turbine the spent gases are dumped out the large fixed area exhaust which has been curved to one side to give the designer extra freedom in installation. Obviously, in a helicopter application the vehicle speed is too low for efficient use of any jet thrust.

The greater part of the development work went into the compressor. GE says it is very advanced—it would have to be to achieve the stated ratio of performance to weight. All that has been officially said about the compressor's internal details is that recent NACA compressor-aerodynamics suggestions have been followed to arrive at the moderately high compression ratio within a modest number of highly loaded stages. Otherwise the internal details are under tight security wraps.

The external appearance indicates a small diameter (slightly over 9 in. as quoted by Hokanson), about an eight stage unit. Along with the Napier Oryx it must be one of the smallest pure axial-flow compressors in existence. In fact, because of the harmful Reynold's number effects on the small blades of such compressors (the last stage blades of the Oryx 12 stage—6:1 compression ratio—are only ½ in. high) many designers say it is impractical to make an axial flow compressor any smaller.

The four rings around the front

Changes in RAF's Vulcan

Avro Vulcans are going into RAF squadron service this year. Leading edge extension on this latest production model artificially thickens chord to increase critical speed and presumably keep tips from stalling. Line of vortex generators has been added to upper wing surfaces. Vulcan is equipped with four Bristol Olympus engines.

A tooling problem?

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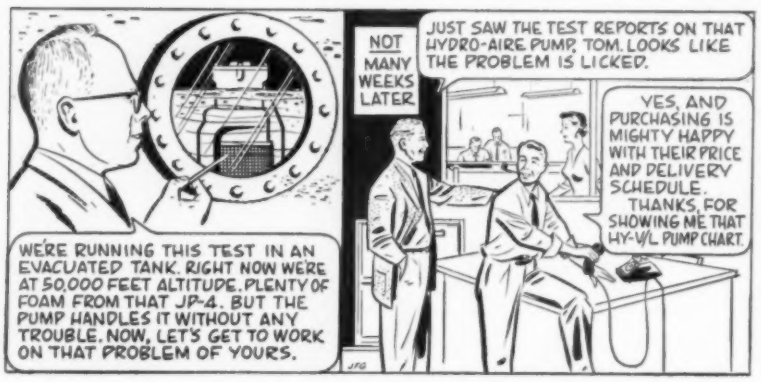
NOT ONE OF THE MANUFACTURERS WE'VE CONTACTED CAN MEET THESE FUEL BOOSTER PUMP REQUIREMENTS, HARRY. THEY NEED TOO MUCH WEIGHT, SPACE AND POWER. GUESS WE'D BETTER REWRITE THIS.
CAN'T AFFORD TO DO THAT, TOM. HMMM - THESE SPECS' ARE TOUGH, ALL RIGHT. NO JOB FOR A SHELF ITEM - TELL YOU WHAT...
PROJECT ENGINEER

CHECK WITH HYDRO-AIRE-THIS CHART OF THEIRS TELLS YOU EVERYTHING ABOUT THEIR NEW HY-V/L* PUMPS. YOU CAN USE IT TO ACTUALLY CHECK OUR REQUIREMENTS AGAINST THEIR DESIGN RANGE. AND THEIR IMPELLER CAN BE SCALED UP OR DOWN TO MEET SPECIFIC NEEDS. I'VE GOT A HUNCH IT'LL WORK.
*HIGH VAPOR-LIQUID RATIO
12 PSI AT 60 GPM--- THERE'S MY POWER REQUIREMENT. SCALE FACTOR---AND WEIGHT. THE BOSS WAS RIGHT! IT CHECKS OUT - BUT CAN THEY DO WHAT IT SAYS ON THIS CHART. I'D BETTER CALL HYDRO-AIRE!

A PHONE CALL --- A MEETING WITH THE SALES ENGINEER --- AND THEN A VISIT TO THE H-A PUMP LABORATORY.

I UNDERSTAND, MR. NICKERSON, THAT THIS PUMP WORKS WITHOUT A VAPOR SEPARATOR.
RIGHT. IT INTEGRATES THE VAPOR INSTEAD OF SEPARATING IT. IT CAN HANDLE MORE VAPOR... DOESN'T NEED EXTRA POWER TO DRIVE THE SEPARATOR. IT'S LIGHTER AND MORE COMPACT.


WE'RE RUNNING THIS TEST IN AN EVACUATED TANK. RIGHT NOW WE'RE AT 50,000 FEET ALTITUDE. PLENTY OF FOAM FROM THAT JP-4. BUT THE PUMP HANDLES IT WITHOUT ANY TROUBLE. NOW, LET'S GET TO WORK ON THAT PROBLEM OF YOURS.
NOT MANY WEEKS LATER
JUST SAW THE TEST REPORTS ON THAT HYDRO-AIRE PUMP, TOM. LOOKS LIKE THE PROBLEM IS LICKED.
YES, AND PURCHASING IS MIGHTY HAPPY WITH THEIR PRICE AND DELIVERY SCHEDULE. THANKS, FOR SHOWING ME THAT HY-V/L PUMP CHART.

An engineers notes on the HY-V/L* *pump*

the problem:

The reduction in the ambient pressure at high altitude causes the fuel in the tank and system lines to boil. The boiling creates vapor. The vapor locks the fuel supply and the engine fails.

Higher ceilings and faster rates of climb have accentuated this problem. The answer: a better fuel booster pump.

the requirements

for this pump are as follows:

1. Low current consumption, especially at full flow — because electrical power is at a premium.

2. Light weight, of course; and compactness.

3. Simplicity of design; easy to service, minimum number of close-tolerance parts.

4. It must handle contaminated fuels and different types of fuel.

5. It must recover instantly if it is stopped and restarted.

the solution:

Hydro-Aire's new HY-V/L pump meets all of these requirements. This pump can handle large quantities of fuel vapor — without a vapor separator — by compressing the vapor back into liquid form inside the pump. It handles boiling fuel with a minimum of disturbance . . . therefore creates less foaming than the conventional booster pump. It has excellent climb performance.

outstanding feature

of the HY-V/L pump is the design of its impeller. Hydro-Aire engineers call it a "dynamically similar" impeller; a base impeller in which each dimension is multiplied by a constant scale factor to get a new diameter. Because of this feature, Hydro-Aire can supply you with a chart to predict the characteristics (weight, size, power requirements, etc.) of a pump to meet your specific needs.

To get this important new chart — and other information about HY-V/L pumps write to:

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P.S. We also make hot air valves, fuel valves, turbo-machinery and the Hytrol Anti-Skid Braking System.

part of the compressor casing are quite provocative as they may be the first public showing of GE practice in variable stator actuator linkage. The GE J79 employs considerable stages of variable stator blading in their high performance J79 (AW Sept. 19, p. 9) which designer Joe Alford says is one way to get around surge on a high compression-ratio compressor without going to dual spool. When questioned about the T58 stator a GE spokesman refused to comment.

If they are variable stator actuators, their existence may explain why it has been possible to achieve such engine performance with so small and so light a compressor.

One good feature about a small compressor, says Hokanson, is that it does have an amazing resistance to foreign and domestic objects. They found during a ten hour test that the T58 could continue to run at full performance even after it had thrown a blade off the third compressor stage. Later inspection indicated that the lost blade had been chewed up by the next three stages whose blades were tough enough to weather the abuse.

The combustor is annular with sixteen fuel nozzles closely spaced around its leading edge. It handles 13 million BTU's per hour. It was purposely made longer than necessary for a low altitude combustor so that it would be compatible with most any type of fuel.

The turbines themselves are perhaps the least novel portions of the engine. They are impulse types, after the usual GE (J47) practice.

Lear MC-1 Autopilot Installed in Boeing 707

Boeing's 707 jet tanker-transport prototype has made more than 19 successful flights since mid-April using a Lear MC-1 autopilot. Lear has the contract for the autopilots for USAF's KC-135 jet tanker produced by Boeing. Lear has had a similar autopilot flying in the Caravelle, French jet transport, for some time.

Reds Support Polar Operations

AN-2 COLT transport attached to the first Soviet Antarctic expedition is refueled by hand pumping from steel drums. This workhorse biplane, in service with Aeroflot, Russian airline, holds an FAI altitude record. Powerplant is a single ASh621R rated at 1,000 hp. Fuselage insignia shows polar bear and penguin; Cyrillic script translates as "Polar aviation", indicating the Reds have a unified support operation serving both poles.

HOUND HELICOPTER hovers over the landing area near the Russian Antarctic base. Under-fuselage package appears to have a transparent front, may be an interchangeable pack used for stores or as an observation position for directing rescue operations. A Russian-built Douglas C-47 (Red designation: Li-2) is visible in the left background.

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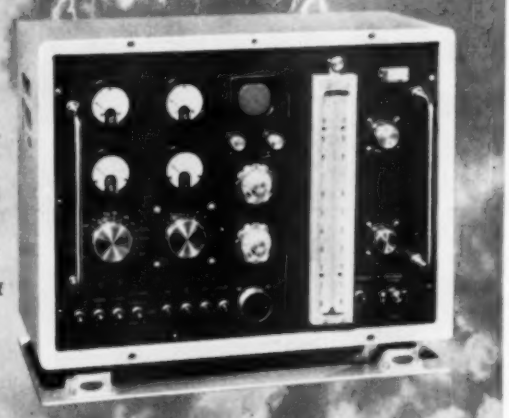

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SEVEN LEAGUES AHEAD

8-1094

McDonnell Locates Tools By Radioactivity

Removal of rivet bucking bars and other small tools from aircraft prior to flight is being insured at McDonnell Aircraft by imbedding a small radioactive source in the body of each tool so it can be located by a scintillation counter during pre-flight inspection.

The McDonnell quality control department inspects each activated tool to see that the proper amount of shielding is provided for the protection of employes. The maximum doses to which workers are subjected are well within the tolerance limits established by the Atomic Energy Commission. Instrument panels containing radium dials and some circuit breaker panels produce more radiation than the loaded tools.

Cesium 137 Advantages

Cesium 137 was the isotope chosen for the radioactive sources because of the following factors:

- **No adverse change** in radiation output occurs during the average life of the tool.
- **Gamma rays** given off are strong enough so that minor obstructions between the source and the detector do not seriously limit detectability.
- **Cesium 137** is available in convenient form and at reasonable cost.
- **Scintillation** counters for gamma rays of this energy have a high detection efficiency thus allowing minimal amounts or radioactivity to be used.

The radioactive source is made up in a vendor's plant and is hermetically sealed in porcelain before being brought to the McDonnell plant. Should a tool fracture, the container can be easily located and disposed of without contact contamination of the surroundings.

The sources are loaded into tools by radiological physicists supplied by Nuclear Consultants, Inc. Tools containing isotopes are indelibly marked to allow easy identification.

Tests indicate that 100% recovery can be accomplished on tools left in planes at any stage of construction.

Authorization for procurement of the radioisotopes had to be received from the Atomic Energy Commission.

Caltech Specifies Mach 9 Tunnel

A $750,000 contract to build, install, and aid in the design of the nozzle, test section and diffuser for a 21-inch hypersonic wind tunnel at the Jet Propulsion Laboratory of the California Institute of Technology has been received by Westinghouse Electric Corp.

The contract was let by Army Ord-

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DYNAMIC IMPEDANCE (ohms)		10	20			11	15		11	15		11	15
AMBIENT TEMPERATURE (°C)	−65		+150		−65		+150	−65		+150	−65		+150
DISSIPATION AT 25°C AMBIENT (mw) (Derate linearly above 25°C ambient)			400				250			250			250
CHANGE IN VOLTAGE DROP (%/°C) −55°C to +25°C −55°C to +150°C			±.01*				±.002*			±.002*			±.002*

*Average values based on entire production of this type
†Rated at 7.5ma and 25°C ‡Rated at 20ma and 25°C

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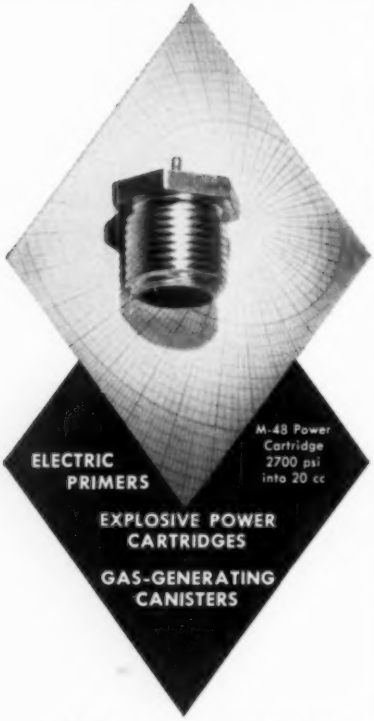

An organization specializing in the design, development, and manufacture of explosive ordnance, McCormick Selph places first emphasis on dependability. The entire group is located in a 60,000-sq-ft plant on a 200-acre site having perhaps the most complete facilities of its kind in existence.

Your procurement and reliability problems in specialized explosives* can probably be solved at McCormick Selph — either with standard items, tried and proved, or with units produced to meet your specific need.

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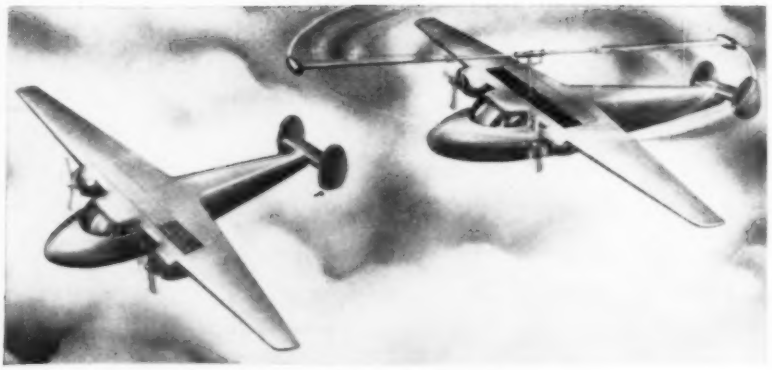


Rotor Designed To Retract

Two-blade, tip-powered rotor has been designed by Hiller Helicopters, Palo Alto, Calif., to fold and retract into a conventional fixed wing. Rotor would be extended for take off and landing, folded for cruising. Ram jet engines in tips are separate and independent of the principal power plant of the aircraft. Structural whirl testing of a 25 ft. diameter model will be conducted soon at the Wright Air Development Center. The study was made under contract with the Air Research and Development Command.

nance. Construction will be at the Westinghouse Sunnyvale, Calif. plant. The tunnel is expected to go into operation in late 1957.

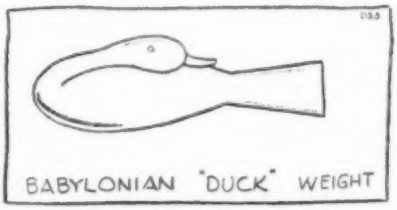
Caltech specified that the tunnel be capable of simulating speeds ranging from Mach 4.5 to Mach 9 or up to 5,940 mph. This is the speed region anticipated for the first stage of the Vanguard satellite rocket.

The Sunnyvale plant has been building the transonic and supersonic compressors for the world's largest wind tunnel, the Propulsion Wind Tunnel at USAF's Arnold Engineering Development Center, Tullahoma, Tenn.

THRUST & DRAG

Hey, you loftsmen: Do you have any idea where the duck weights came from that you use to hold down those long flexible splines? Or why they called "duck" weights in the first place?

The Babylonians used them, and in their language, called them "ducks"—they took their shape from a stylized duck, and they were the standard weights of the kingdom. Here's a sketch:



One observant aerodynamicist says if the area rule is generally true, girl swimmers should be faster than boy swimmers.

Another writes to ask: Is area rule better than mass rule?

At Makovski 5: Hypersonicvich

There are two kinds of brochures: Typed ones, which are estimates, and printed ones, which are lies.—De Havilland Gazette.

Ever hear of the Makovski Number? Thousands of Russian aeronautical engineering students have. It's the ratio of airspeed to the speed of sound, and is named after a Russian ballistician. The abbreviation for Makovski number—the letter M—has received world-wide acceptance, Russian students are told.

The next thing we'll be hearing is that the West's abbreviation for lift coefficent—C_L—actually is named in honor of that great Russian aerodynamicist Constantin Lomonosov.

Comment on phony security:

"The strongest guard is placed at the gateway to nothing . . . The condition of emptiness is too shameful to be divulged." —F. Scott Fitzgerald.

McDonnell's Subcontracts Pass $200 Million Mark

McDonnell Aircraft Corporation's volume of business currently placed with major subcontractors has passed the $200 million mark. The company recently announced a backlog of $627 million in aircraft and missile orders.

Biggest McDonnell subcontractor is Temco Aircraft Corp. of Dallas, Tex., with orders of $72.6 million. Temco manufactures components for Navy's F3H-2N Demon, USAF's F-101 and RF-101A. Next largest subcontractor is Glenn L. Martin Co. of Baltimore with $58 million in orders for F-101 wings.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

BUREAU OF AERONAUTICS, Washington 25, D. C.

General Electric Co., 1 River Rd., Schenectady, N. Y., Type MA-1 compass systems, NOas 56-334-f(PD-42-1244-56), 453, $1,384,621.

United Aircraft Corp., (Hamilton Standard Div.), Windsor Locks, Conn., materials & services required to modify and rework (18) Government-owned model A3470 propeller assemblies, NOas 56-378-d(MA-32-4562-56), job, $337,442.

Westinghouse Electric Corp., 1625 K St., Washington 6, D. C., disconnect, move, pack, crate and preserve machine tools and related capital equipment, NOas 56-530-c(IP-33-6030-56), job, $25,000.

General Electric Co., 1 River Rd., Schenectady, N. Y., rachometer indicators, MS-28000-1, NOas 56-532-f), (PD-42-1194-56), 1734, $119,621.

Laboratory for Electronics Inc., 75 Pitts St., Boston 14, Mass., design, develop, fabricate and furnish models of a self-contained navigation system for rotary wing aircraft, NOas 56-560-c(AE-73-1856-56), 1 1 1 2, $399,012.

Binks Mfg. Co., 3114-40 Carroll Ave., Chicago 12, Ill., equipment and installation for explosion proofing one paint and resin coating baking oven; and to convert baking oven and related equipment from 350°F operating temperature, NOas 56-673-f(MA-46-5141-56), $97,333.

Chrysler Corp., (Defense Operations Div.), P. O. Box 1687, Detroit 31, Mich., study of test techniques for J-65 engine fuel controls, NOas 56-702-c(MA-45-5198-56), $53,-872.

Grimes Mfg. Co., Urbana, Ohio, landing signal officer lighted suit equipments consisting of various components such as: control boxes; paddles; horizontal light strips; vertical light strips, etc., NOas 56-787-f(MA-36-4633-56), 150, $108,180.

Burner-Holloman Mfg. Corp., 4706 Rhode Island Ave., Hyattsville, Md., universal jet engine overhaul stand, NOas 56-843-f(MA-45-5110-56), 200, $268,800.

The Jam Handy Organization, Inc., 2821 E. Grand Blvd., Detroit 11, Mich., preparation of master shooting scripts and partial storyboards for motion picture training films, NOas 56-332-f(PH-51-2491-56), 4, $48,380.

Graflex, Inc., Rochester 8, N. Y., 70 mm camera body adapter for submarine periscope NOas 56-508-f(PH-3-2407-56), 203, $262,828.

Collins Radio Co., Cedar Rapids, Iowa, services of qualified technically-trained employes to provide technical assistance and instructions in the maintenance of aircraft electrical and electronic equipment, NOas 56-147-S(MA-35-4412-56), 72 man-months, $82,514.

General Dynamics Corp., (Convair Div.), San Diego 12, Calif., services of (3) factory trained instructors for the purpose of conducting (14) four-week courses of instruction in the maintenance of R4Y airplanes, NOas 56-165-f(MA-34-3421-55), $28,753.

Ryan Aeronautical Co., San Diego, Calif., target drones, KDA-1 letter contract NOas 56-253, 80, $2,115,043.

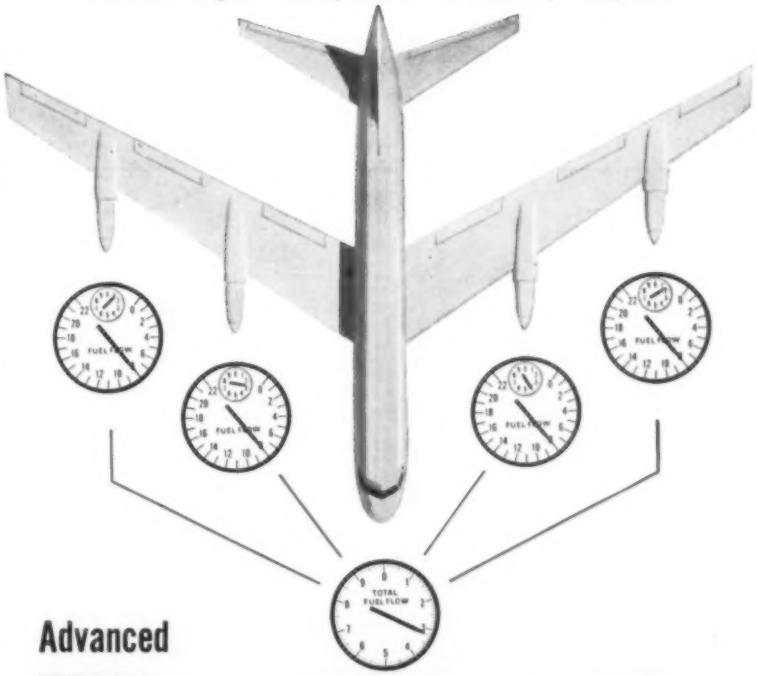
Hoffman Laboratories, Inc., 3761 South Hill St., Los Angeles, Calif., APG-30A receiver-transmitters, voltage regulators and power suppl, NOas 56-257-f(PD-31-749-56), 700, $1,074,045.

Sperry Rand Corp. (Sperry Gyroscope Co. Div.), Great Neck, Long Island, N. Y., gyro horizon indicators, NOas 56-301-f(PD-42-1177-56 & Change A), 1270, $844,550.

North American Aviation, Inc., (Atomics International Div.), Box 309, Conoga Park, California, conduct a development program to provide a radiation type fuel gage design for laboratory and flight test evaluation, fabricate and furnish (4) gages, NOas 55-924-d (AE-71-653-55), $75,000.

Holly Carburetor Co., 11955 East Nine Mile Rd., Van Dyke, Mich., acquisition and

Better way to keep tab on thirsty engines



Advanced

Bendix FUEL FLOW TOTALIZING SYSTEM

TYPE 9130

makes news because it...

- Is designed for commercial and military jet and piston aircraft—both multiple and single engine.
- Reports fuel consumption from 400 to 2,250 PPH* for individual engines (Type 37100 Indicator)... and total consumption for all engines (Type 36722 or 36750 Indicator).
- Provides system accuracy of 2% individual rate and 3% total rate.
- Is pressure tested to 1600 psi.
- Has low pressure drop—only 1.0 psi.
- Is simple to install and service.

*Other ranges available.

Development of new, faster—and thirstier—commercial and military aircraft makes it more essential than ever to have complete and accurate indication of fuel consumption. This new Bendix Fuel Flowmeter System features fuel flow transmitters and indicators *specially developed* for today's—and tomorrow's—greater needs. For full details check with PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, DAVENPORT, IOWA.

P-C offers qualified engineers challenging, profitable careers

West Coast Office:
117 E. Providencia Avenue,
Burbank, California

Export Sales and Service:
Bendix International Division,
205 E. 42nd Street,
New York 17, New York

Canadian Distributor:
Aviation Electric Ltd.,
200 Laurentien Blvd.,
Montreal, Quebec

Pioneer-Central DIVISION

Bendix AVIATION CORPORATION

FACTS

about

NEW DEPARTURE
BALL BEARINGS

Split Inner Ring Main Shaft Ball Bearing

FOR AIRCRAFT TURBINES

High speeds, high temperatures and heavy loads . . . both radial and thrust . . . characterize bearing applications for turbines used in present ultra-fast aircraft.

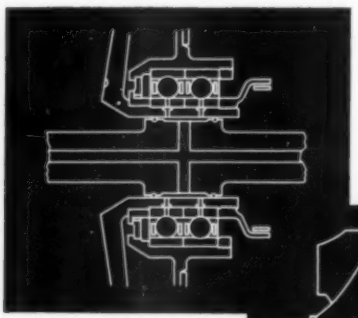
New Departure's Aircraft Bearing Research Program has produced ball bearings for highly satisfactory operation in small, medium and large turbines and their accessories.

Under this program, ball bearings of different steels dimensionally stabilized for high-temperature operation have been developed and produced. Needs for bearings with high-thrust capacity and varied lubricating methods have been met. And, bearings with various geometrical specialities to satisfy difficult mounting and operational requirements were designed.

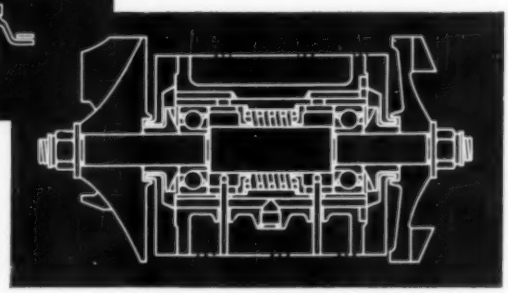
Beyond this, New Departure is working on bearing developments for the more powerful, faster aircraft of tomorrow.

For further details, send for Folder TB, on turbine bearings.

Accessory Ball Bearings



LEFT: Split Inner Ring Bearings on Turbine Main Shaft



RIGHT: Typical Installation of Ball Bearings in a Refrigeration Turbine

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

installation in contractors plant, Van Dyke, Mich. of jet engine fuel control est stands, NOas 56-023-c(IP-31-9294-51), $300,000.

The Kaman Aircraft Corp., Bloomfield, Conn., provide for the design and engineering work required to install an all-weather instrumentation system in an HOK-1 helicopter, make installation, conduct ground and flight tests, reports, NOas 56-100-c(AE-73-1836-56), $74,142.

Bell Aircraft Corp., Fort Worth, Tex., HTL-6 helicopters letter contract NOas 56-131(PD-11-235-56), 24, $893,912.

Radiophone Co., 8000 Woodley Ave., Van Nuys, Calif., target drones, KD2R-5 NOas 56-141-f(PD-24-247-56), 1135, $3,601,355.

General Electric Co., French Road, Utica, N. Y., field engineering services to provide technical assistance and instruction in connection with the maintenance, repair and operation of aircraft electrical and electronic equipment, NOas 56-168-s(MA-30-4417-56), 120 man-months, $148,301.

Pratt & Whitney Aircraft, Inc., (Chandler-Evans Div.), West Hartford 1, Conn., services of (2) factory trained field service technicians to provide instructions to Naval and Marine personnel in the maintenance and servicing of carburetors, NOas 56-198-c (MA-33-4425-56), $33,686.

The Garrett Corp. (AiResearch Mfg. Co. of Arizona Div.), SkyHarbor Airport, 402 S. 36th St., Phoenix, Ariz., services of (12) factory trained field technicians to provide instruction to Naval personnel in the maintenance and operation of equipment manufactured by the contractor, NOas 56-202-s (MA-33-4455-56), $223,008.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst 73, N. Y., indicators, rate of climb, AN 5825-7, NOas 56-317-f(PD-42-1167-56 & change A), 800, $55,312.

Vitro Laboratories, West Orange, N. J., investigate the feasibility of the electrophoric disposition of uniformly thick, bonded solids onto plastic radomes for prevention of erosion, NOas 56-382-c(EL-41-2687-56), $33,950.

The Garrett Corp., AiResearch Mfg. Co. of Ariz Div., Sky Harbor Airport, 402 S. 36th St., Phoenix, Ariz., overhauls and/or conversion of GTCP85-4 dual purpose gas turbine power units NOas 55-870-f (PP-32-790-55), job order, $30,000.

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

Bendix Products Div., Bendix Aviation Corp., 401 Bendix Drive, South Bend 20, Ind., strut assemblies, (383/2110-1875/52/Aero, 383/2110-1887/52/Aero), various, $222,467.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., computer, (383/2120-630X6/3/52/Aero), various, $30,360.

Benjamin Franklin Paint & Varnish Co., 4820 Langdon St., Philadelphia 24, Pa., enamel, (IFB 383-874-56), 7500 gals., $42,532.

The Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio, enamel, (IFB 383-874-56), 30000 gals, $89,874.

United Aircraft Corp., Pratt & Whitney Div., East Hartford, Conn., services & material, (MIPR 33-600-6-02A-195), various, $450,000.

Air Associates Inc., Teterboro, N. J., actuators, (383/2150-1519X1/3/52), various, $41,184.

Airesearch Mfg. Co., Garrett Corp., 9851-9951 Sepulveda Blvd., Los Angeles 45, Calif., thermostat Assys, (383/2110-142/54), various, $61,516.

Bill Jack Scientific Instrument Co., Solanda, Calif., maintenance parts, (383/2140-2296/52), various, $27,390.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., amplifiers, (383/2120-615X6/3/52, 383/2110-2126/52), 305 ea., $106,360.

The Seamless Rubber Co., 253 Hallock Ave., New Haven, Conn., bladder assys, (IFB 383-1046-56), 161500 ea., $358,126.

Turnbull Enterprises, Inc., 1414 Lovegrove St., Baltimore, Md., kits: mooring, (JD-IFB-383-956-56), 776 ea., $43,099.

Dow Corning Corp., Midland, Mich., compound, (IFB 383-1032-56), 30600 tubes, $67,320.

The Leland Electric Co., Div. American Machine & Foundry Co., 1501 Webster St., Dayton 1, Ohio, inverters, (IFB 383-1055-56), 76 ea., $37,111.

Blythe Aircraft Corp., 2201 Commonwealth Ave., Alhambra, Calif., buoys, (383/29065-13G2/1/56/Aero), various, $44,858.

The Cleveland Pneumatic Tool Co., 3781 E. 77th Street, Cleveland 5, Ohio, trunnions, (383/2150-1590X7/3/52/Aero), 43 ea., $41,177.

Airesearch Mfg. Co., Div. of The Garrett Corp., 9851-9951 Sepulveda Blvd., Los Angeles 45, Calif., oil coolers, (383/2110-1930/52/Aero), 357 ea., $199,499.

Mine Safety Appliances Co., 201 N. Braddock Avenue, Pittsburgh 8, Pa., mask assys, (383/29045-70G3/25/Aero), 3050 ea., $87,066.

Elcon Mfg. Co., 436 E. Manchester Ave., Los Angeles, Calif., batteries, (JD-383/2140-2574E5/3/52/Aero), 9100 ea., $79,625.

Airesearch Mfg. Co., Div. of The Garrett Corp., 9851-9951 Sepulveda Blvd., Los Angeles 45, Calif., actuators, (383/2110-913/53/Aero, 383/2110-235/54, 383/2110-74/55/Aero), 266 ea., $39,014.

Holley Carburetor Co., 11955 E. Nine Mile Rd., Van Dyke, Mich., maintenance parts to support J57-P37 engines valves, (MIPR 41-608-5-03D-1132 Amend. 19), various, $57,738.

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 3, Mo., parts for F2H aircraft, (383/2110-1798A1/4/51), various, $60,006.

Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich., maintenance parts for Vickers pumps, (383/2150-1469/52/Aero), various, $27,552.

Holley Carburetor Co., 11955 E. Mine Mile Road, Van Dyke, Mich., maintenance parts used to support various Holley fuel controls and valve assys, (383/2117-209/51/Aero), various, $189,517.

Holley Carburetor Co., 11955 E. Nine Mile Road, Van Dyke, Mich., maintenance parts to support Holley control fuel, (383/2117-212/51/Aero), various, $121,143.

when *your life* depends on it

. . . Flying at 40,000 feet . . . a sudden emergency . . . if you must bail out, the difference between life and death now depends on the instant release of your oxygen and electrical leads. In a split second, these life lines during normal flight can change into a death trap, binding you to your disabled craft or bleeding your portable oxygen supply to atmosphere.

The necessity for providing safe emergency exit from aircraft at high altitudes and trans-sonic speeds is another one of the problems which has been solved through the constant research of the Aerotec Corporation. Aerotec Personal Lead Disconnects give both manual "convenience" operation as well as automatic release at the moment of ejection . . . provide one more unseen helping hand for the pilot.

The Aerotec Oxygen Disconnect and many other aircraft developments are the result of continuing research. Why not let our laboratory help solve your problems?

AEROTEC

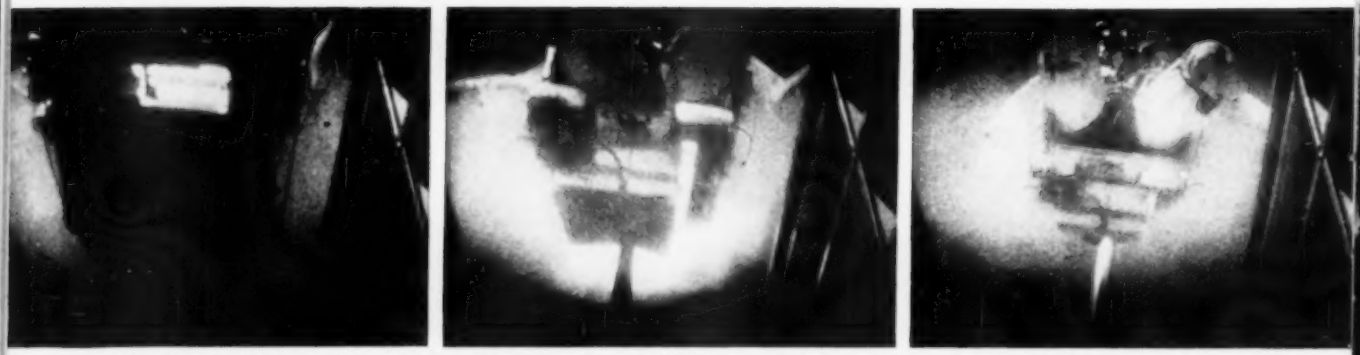
Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.

(Offices in all principal aircraft centers)

Canadian Affiliates: T. C. CHOWN, LTD., 1440 S. Catherine St. W., Montreal, Que.

THE AEROTEC CORPORATION

Aircraft Division Greenwich, Conn.



CAMERA, on sled floor in Hurricane Mesa, Utah, run, shows bottom of seat (left), firing (center), and legs of dummy as seat leaves.

FROM PRONE POSITION dummy turns head-down. Pictures were made at rate of 800 per second on 600-mph. sled.

Camera Catches 1,000 Pictures Per

By George L. Christian

New York—A new series of high speed, motion analysis cameras capable of 32 to 5,000 pictures per second has been developed by Fairchild Camera and Instrument Corp.

Designer John H. Waddell told AVIATION WEEK the cameras, called the Fairchild Motion Analysis Cameras (MAC), were developed for other uses besides the military.

"In designing the units," Waddell said, "company engineers tried to outstrip the MIL specs . . . our MAC units are so advanced that their existence will signal a change in the state of the high speed motion picture art."

Light and Rugged

The cameras and their associated equipment, such as 28 v. power packs and special, 300-watt lamps, are small and light enough to be truly portable. The cameras alone weigh from 9 to 11 lb. depending on the model. Waddell said the cameras were built with a "briefcase concept" in mind to provide an easily portable high speed photo lab.

The MAC cameras, which use 16-mm. film in 100 or 200 ft. rolls, are available in two basic models, each of which has several variations. (Later models, using a newly developed thin film, will have 40-ft. capacities.)

Two Models

The two models currently available are:

- **HS100, airborne unit,** 4 in. wide, has a pps. (pictures per second) speed range of 100-1,000, and weighs 11 lb.
- **HS101, industrial unit,** 7 in. wide, has a pps. range of 32-5,000, and, oddly enough, weighs 9 lb., 2 lb. less than the airborne version.

First production models of the MAC cameras already have seen military service. One unit took a lens-rattling, 1,200-mph. ride on a supersonic sled at the Naval Ordnance Training Station (NOTS), Invokern, Calif. The camera functioned perfectly despite initial acceleration loads of 200Gs, and continuous vibration loads of 50Gs which were severe enough to loosen some of the lenses.

This portion of the camera will be made more rugged.

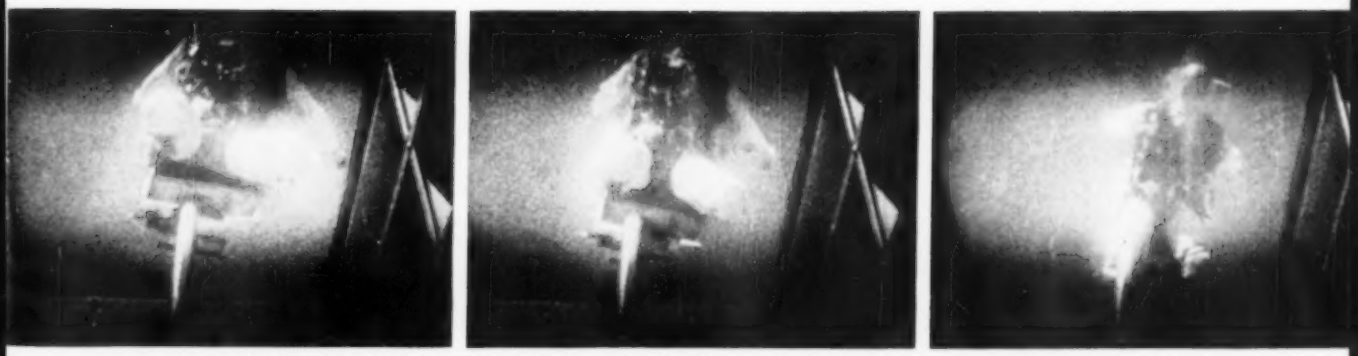
The color film record of the supersonic ride was shown to the press. Some impressions: The color was bright and quite natural; the 1,000 pps. filming rate slowed the 1,200-mph. ride to the pace of a leisurely Sunday afternoon auto ride; the extreme roughness of the ride and severe jarring of the camera was vividly translated to the screen.

Dummy Blasted

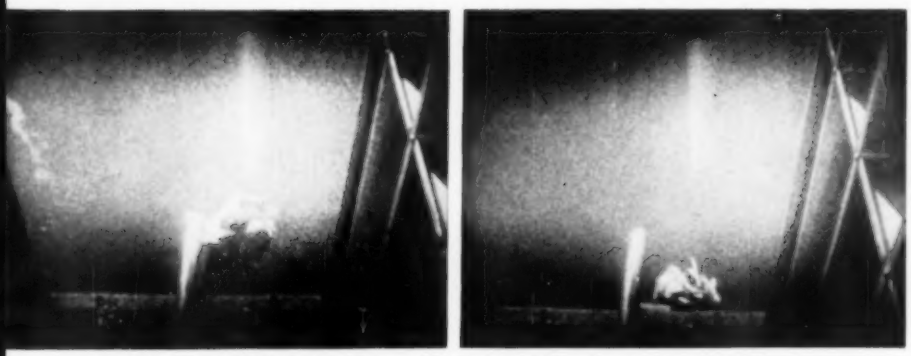
Other MAC cameras have been used successfully to photograph a 600-mph. sled run during which an anthropomorphic dummy was blasted out in an ejection seat.

One camera, facing backward, rode on the floor of the rocket-propelled sled, filming the ejection sequence at close range. It was subjected to 60G deceleration forces.

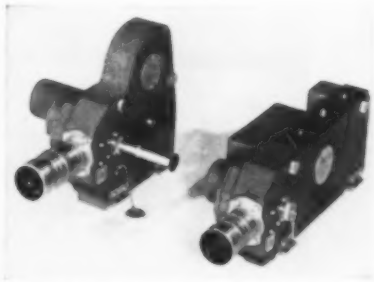
A second MAC camera, stationed near the sled track, recorded the run from the ground.



SIGNIFICANT SEQUENCE shows dummy gradually beginning forward tumble. Dummy is chest down in V-posture at right.



DUMMY DISAPPEARS AFT. Time elapsed since first picture is about 1/70th of a sec.



INDUSTRIAL model HS101 is at left, airborne model HS100 at right.

Second On Supersonic Sled

Both cameras operated at a rate of 800 pps.

Here are some other aviation applications Fairchild officials see for their high speed camera:

- **Missile launching** and flight phenomena investigation.
- **Vibration detection in** helicopter blades; a MAC camera is already at work on such a project. It is attached to one of the blades and takes high speed motion pictures of the hub and rotor assembly for one of the country's leading helicopter manufacturers.
- **Release of bombs** and other internally or externally-mounted stores.
- **Acceleration and deceleration** effects on flight crew members and aircraft equipment, such as that experienced during catapult takeoffs and arrested landings.
- **Wire laying from aircraft** to determine best equipment and procedure.
- **Propeller synchronization** studies on multi-engine aircraft. (A demonstration film of a DC-6 takeoff showed clearly that the props on engines number 1, 2 and 3 were well synchronized but number 4 was turning appreciably faster than the others).

Still other possibilities include: high speed bailout and ejection; effects of high speed and hard landings on tires and landing gear struts; jet engine destruction tests; aerial spray studies, and structural vibration investigation.

Non-aviation uses run the gamut from studying heart auricle activity during operations in the chest cavity to studying high speed cookie packaging.

Inside the Case

Inside the MAC cameras' heat-treated, cast aluminum alloy cases, Fairchild technicians engineered the lightest possible drive motor and drive mechanism compatible with their rugged construction.

Example of the efficiency of the components used in the MAC cameras is the 1½ hp., short duty cycle electric drive motor which can accelerate the film from stand-still to 3,000 pps. almost instantaneously. With the help of a second motor, the film can be whipped through the industrial version of the camera at 5,000 pps., which gives it a speed past the lens of 125 ft. sec. or about 90 mph. Exposure is 1/25,000th of a second.

In operation, film is wound off the supply spool over a free-turning sprocket wheel which feeds it past the lens and a rotating prism to the power-driven take-up spool.

Precision prism drive gearing assures much better projection picture steadiness than that obtainable with intermittent cameras, and resolution is equal to or better than the best motion picture photography produced by intermittent cameras, according to Fairchild spokesmen.

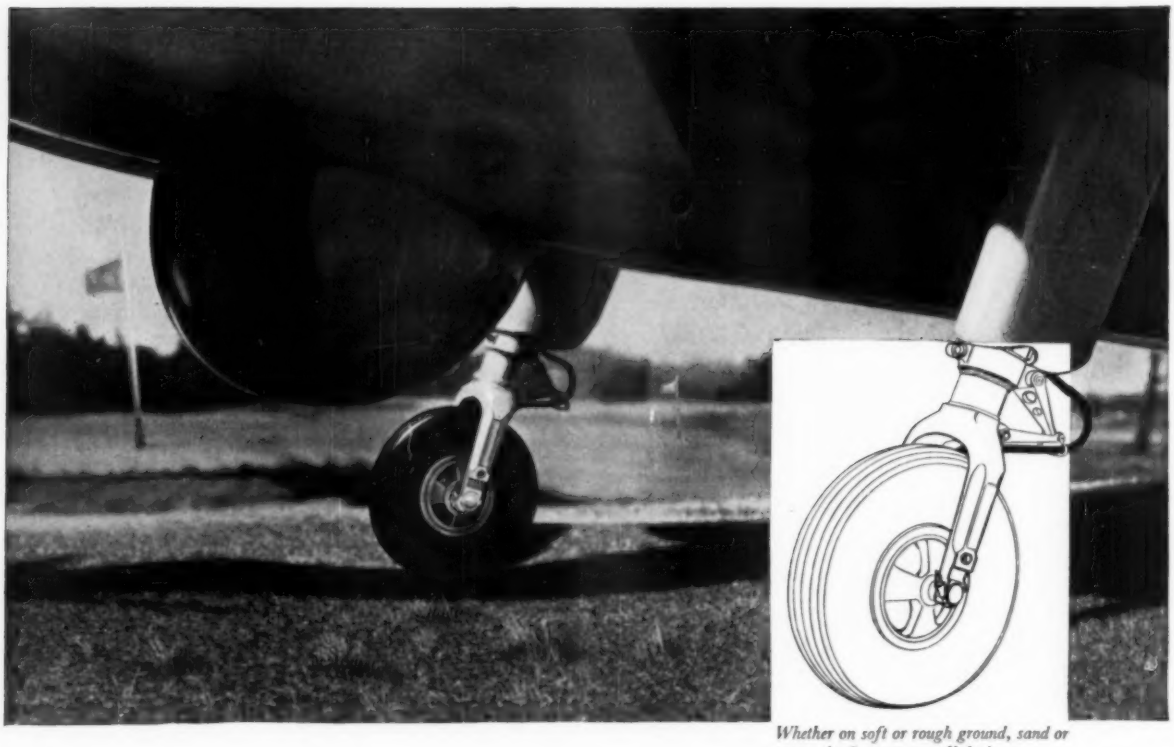
Rare Element Prism

The camera's four-sided, rotating prism "sweeps" scene light on the continuously-passing film as it is fed over the sprocket wheel.

Here is how Fairchild engineers describe it:

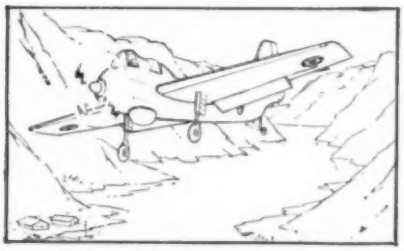
"The rotating prism has been selected for the highest possible index of refraction and the lowest dispersion rate with a minimum thickness and a minimum angle of incidence. The result is an evenly illuminated picture that has a sharp frame line, with no

Golf course fairway — *Seamew* runway



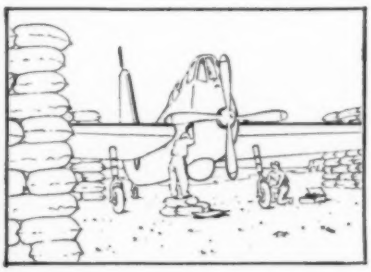
Whether on soft or rough ground, sand or grass, the Seamew can alight in an extremely small area because of its low landing speed and long oleo leg travel. Tyre sizes can be easily changed to suit terrain.

Seamew — a tough, economical, all-weather submarine hunter. In adverse weather — submarine weather — the Seamew can be airborne after a short take-off from an emergency strip . . . can conduct a radar search and low-level attack . . . and can land back safely almost anywhere (even on a golf course!) — due to its slow approach speed and shock-resisting undercarriage.



The extremely good handling characteristics of the Seamew combined with simplicity of construction and clear vision make it an excellent aircraft to fly, even for pilots with little experience of this type.

The *Short* answer is the *Seamew*



Economy of manufacture is paralleled by economy of maintenance, in terms of man-hours and spare components.

NOW IN PRODUCTION FOR THE ROYAL NAVY AND THE ROYAL AIR FORCE

Short Brothers & Harland Ltd., Queens Island, Belfast, N. Ireland. The first manufacturers of aircraft in the world

overlapping of images from the one frame to the next.

"Since the introduction of high speed color film, glasses of higher indices of refraction could not be used because they have color—generally yellow. Therefore, a rare element glass was selected for the prism which is as nearly 'water white' as possible and still has a high index of refraction and a low dispersion. Thus, the image produced is free from 'color fringing' and color photography is possible without the use of color correction filters.

"The rotating prism shaft of the MAC cameras is so mounted that the camera will operate at 55Gs without causing optical distortion or malfunction. Picture tests of live subjects indicate . . . a steadiness which makes it possible to make single frame enlargements from the original film."

Here are some other features of the MAC cameras:

• **An adjustable** brake on the feed spool can be set to prevent overrun when the camera is stopped and started during high speed runs.

• **The cameras** will operate at temperatures ranging from −65F to +200F.

• **Four motor setups** are available for the MAC cameras, and the motors can be interchanged within a minute.

• **The airborne camera,** which measures 11 x 4½ x 4 in. is provided with a 13 mm. f. 1.5 lens with bayonet mount. Other interchangeable lenses range from a 13 mm.-152 mm. Camera price is $1,375.

• **The industrial camera,** which measures 7 x 6½ x 8½ in., normally is provided with a 75 mm. f. 1.9 lens. It also will accommodate lenses ranging from 13 mm.-152 mm. This camera incorporates two AN-type connectors—one for power, the other for a timing light. Price is $1,190.

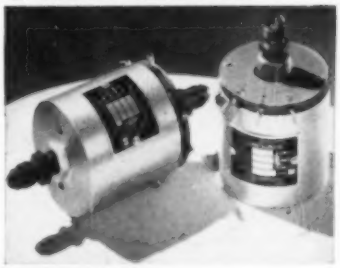
Mid-Air Refueling Saves Navy Fighters

Mid-air tanker refueling in the nick of time recently saved two Navy fighters from Davy Jones' Locker.

In one instance an F-2H Banshee scheduled to rendezvous with a tanker lost radio and radar contact and failed to show at the appointed refueling station over the Mediterranean. After a search the fighter was located. With 2½ min. of fuel remaining a North American AJ tanker refueled the F-2H and it returned safely to its base.

In another case the pilot of a Grumman F-9F found he could not land immediately because of a "fouled" carrier deck. He was faced with ditching when refueled by an AJ tanker and was able to remain aloft until the deck was cleared.

AIRCRAFT TRANSDUCERS



PRESSURE OPERATED POTENTIOMETERS

Outputs: Linear and nonlinear functions of applied pressure.
Resistances: 100 to 50,000 ohms.
Ranges: 0-5 to 0-5000 psi.
Types: Absolute and differential.
Vibration Ambient: 0 to 55 cps, 0 to 500 cps, and severe vibration 25g to 2000 cps.
Construction: Hermetically sealed.

Write for Pressure Operated Potentiometer Bulletin

ULTRA-SENSITIVE PRESSURE SYSTEM

Output: 50 volts at full scale.
Range: ±¾ psi, differential.
Resolution: 1 x 10^{-6} psid.
Zero stability: Better than 1 x 10^{-3} psid.

Write for Bulletin EPMS

RESISTANCE BRIDGE PRESSURE PICKUPS

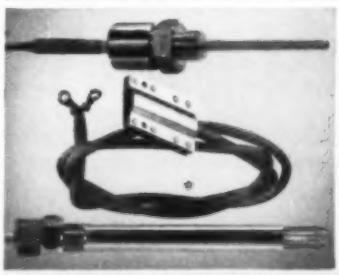
Sensitivity: 5 mv/v at full scale.
Ranges: 0-10 to 0-1500 psi.
Types: Absolute and differential.
Construction: Hermetically sealed.

Write for Bulletin No. 7

RATE OF CLIMB

Outputs: 5 volt signal and/or dial indicator.
Range: ±25,000 ft./min.
Time constant: 0.2 sec. at sea level to 2 sec. at 50,000 ft.

Write for Vertical Speed Transducer Bulletin



RESISTANCE THERMOMETERS

Resistance: 5 to 500 ohms at 32°F.
Materials: Platinum or nickel.
Range: −350 to +2000°F.
Types: Liquid, surface, gas.
Characteristics: Corrosion proof, severe vibration ambient, fast speed of response.

Write for Resistance Thermometers Bulletin

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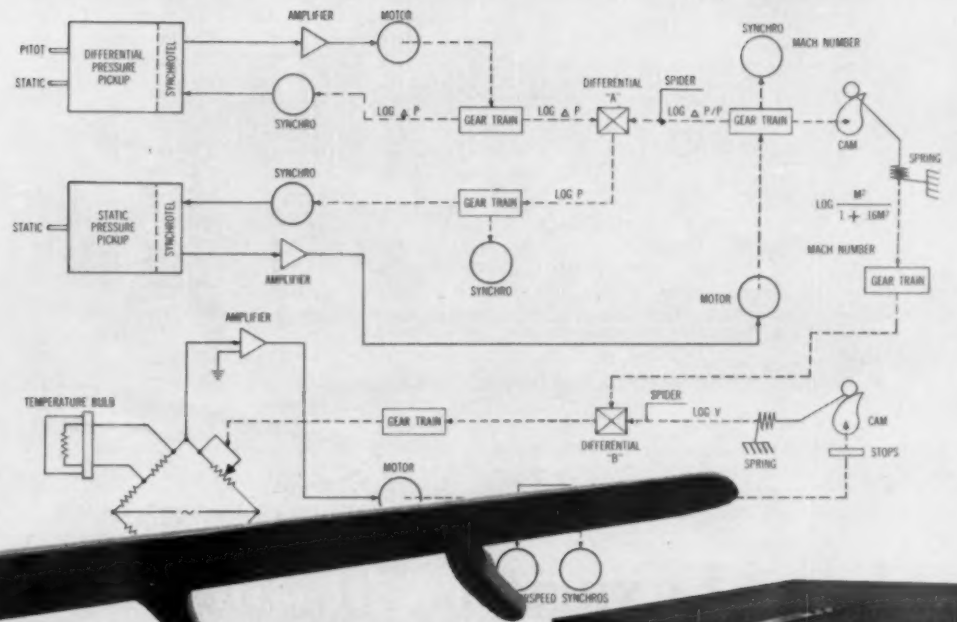
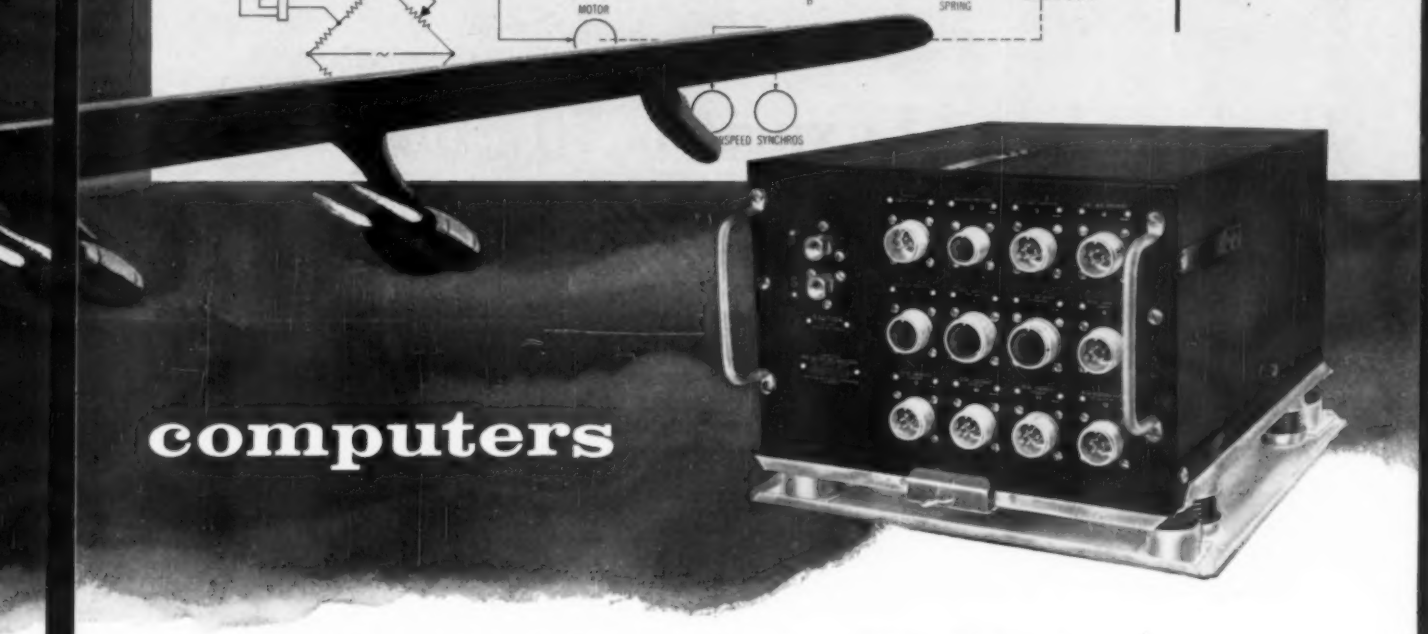
The key elements of the Kollsman Air Data Computer System are the Synchrotel Transmitters and the Pressure Monitors, using displacement type diaphragms, to provide the necessary inputs. These Kollsman units have had their reliability proven again and again by the thousands now in use. And, there is more than 28 years of unique experience behind the development and perfection of the displacement type diaphragm by Kollsman. That's why you can expect superb performance and accuracy characteristics in a Kollsman Computer.



OPERATIONAL SCHEMATIC TYPICAL COMPUTER

KEY:
- - - MECHANICAL CONNECTION
—— ELECTRICAL CONNECTION



computers

...now available in systems such as the following:

Air Data	Master Air Data	Temperature and Humidity
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The outputs of such computers, having accuracies better than .5% of range, are specified functions of the following:

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Indicated Airspeed	Mach Number	True Temperature

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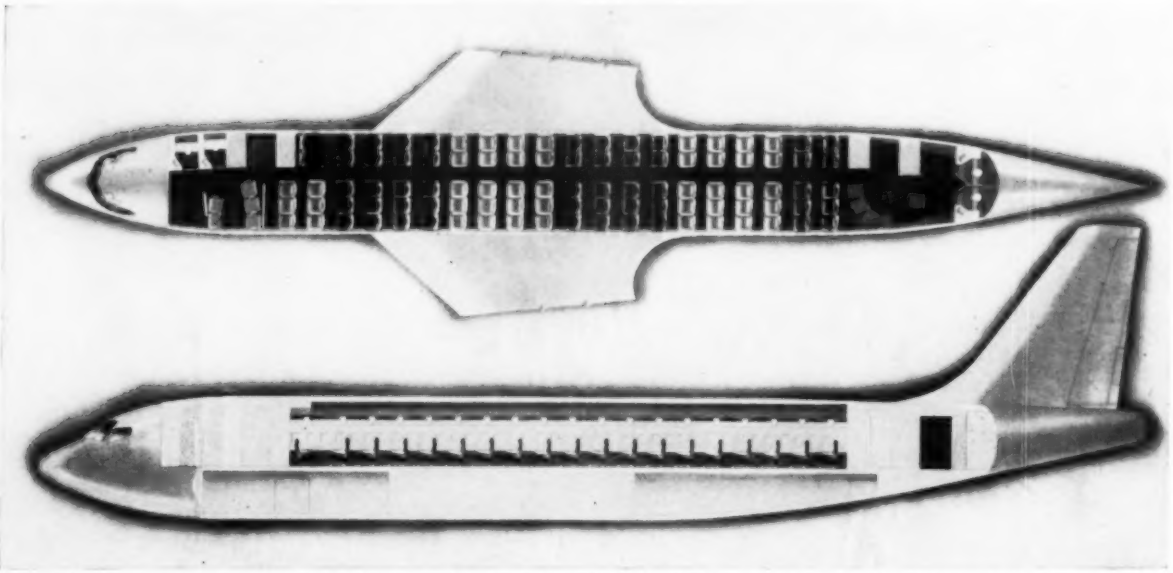


SEATING arrangements in cabin allow quick conversion from four to five to six abreast. Much of cabin interior is plastic.

Boeing Shows Luxurious 707 Interior

New York—In a cool, lofty room on the eighth floor of a building on Manhattan's East Side, an experiment in sales techniques is taking place that may well be a bellwether for many an aircraft manufacturer operating in this highly-competitive jet age. It's a show being put on by the Boeing Aircraft Co., a luxurious, complete mockup of an interior of the company's new 707 Jet Stratoliners designed by the firm of Walter Dorwin Teague Associates.

The cabin mockup, which has been abuilding since last November, is breathtaking in its detail and in the luminous colors which abound—yellows, pinks, glacier blues, oranges and pastel greys.

And the list of those real and potential customers who have viewed the exhibit to date can be taken as an example of its effectiveness. Among these have been:

• **American Airlines**—C. R. Smith, president; O. M. Mosier, vice president; C. R. Speers, vice president; G. J. Brandewiede, vice president for purchasing and stores; R. E. S. Deichler, vice president for customer service; M. Whitlock, vice president for maintenance and engineering; W. Littlewood, vice president for equipment research.

• **Braniff**—Charles E. Beard, president; Jay Jackson, vice president; C. G. Adams, vice president.

• **Continental**—Robert F. Six, president; C. H. Calhoun, vice president for engineering and maintenance; Harold L. Lawrence, vice president for traffic and sales; Matt Kramer, territory sales manager.

• **TWA**—John A. Collings, executive vice president, and a working group of 22 persons.

• **Air France**—Louis Lesieux, president; H. J. Lesieur, general manager; Pierre Fromheim, operations manager.

• **Sabena**—D. L. du Vivier, general manager.

• **Lufthansa**—Eberhard Jacob, operations manager.

During the first few days of the mockup's operation approximately 150 airline and aircraft industry executives

CABIN has two five-seat luxury lounges. Bulkheads separating lounges from cabin may be removed for additional seats.

and employes inspected the cabin. Boeing expected twice that number to go through it within the month.

"Airline VIP's have been uniformly enthusiastic," a Boeing spokesman said. "Their reaction definitely is that the mockup is proving a very useful selling tool both for those already signed for 707's and those still in the prospect class."

The Teague organization's philosophy of design in airline craft is to eliminate the "textile look" (AW May 14, p. 92). But even so, Teague does not believe in fussy curtains on windows or other frills. Special plastic slides either eliminate glare or black out the windows entirely. Most of the cabin interior—walls, ceiling and baggage racks—are made of plastic or plastic laminated on metal. The cabin also is given a spacious feeling by the large number of windows, about twice the number usually found on transport aircraft.

Other Features

Other features of the half-million dollar installation:

- **Loud speakers whisper** an actual—but very hushed—reproduction of the prototype 707's jet engine noise.
- **Daylight-type illumination** outside the frosted cabin windows passes gently from the full glare of daytime flight at 40,000 ft. to the opaqueness of a moonless night.
- **Individual speakers,** at each half-row of seats have the clarity of hi-fi reproduction.
- **Dome lights along the ceiling** can be dimmed to sunset-red hues or darkened to deep, night blue with brilliant stars. The blue illumination can be left on as minimum light for night flights.

The mockup is unusually complete. The cabin's three lighting systems operate as they would in the production airplane. Water runs in the two galleys and four lavatories, air conditioning keeps the cabin at pleasant temperatures. The galleys are equipped with electric ovens, hot and cold, push-button-controlled liquid dispensers and refrigerators.

The two passenger entrance doors are replicas of actual plane doors as are the two galley access doors. Life rafts are stowed in ceiling racks and emergency evacuation chutes are packed in floor-level closets.

Removable Panels

Other standout features of the Teague interior are easily removable, prefabricated wall and ceiling panels. Passenger service units are slung from the bottom of the baggage rack instead of being installed on the cabin sidewall. The prefabricated, plastic or plastic-laminated-on-metal panels are quickly and easily removed to permit inspection or repair of the aircraft's structure. In addition they are dirt resistant and easy to clean.

By taking the passenger service items off cabin walls and combining them into one pylon per half-row of seats, Teague has greatly increased the flexibility of the 707's interior. The pylons are mounted on tracks, as are the seats, so that each pylon can be placed in its correct position above the seat it services, regardless of seat spacing. The distance between seat centers may be adjusted.

Combined in the pylons are small no smoking and fastened seat belt signs, a loud speaker for the public address system, and individual emergency oxygen masks, reading lights, ventilators and cabin attendant call buttons.

By using fully cantilever seats, great

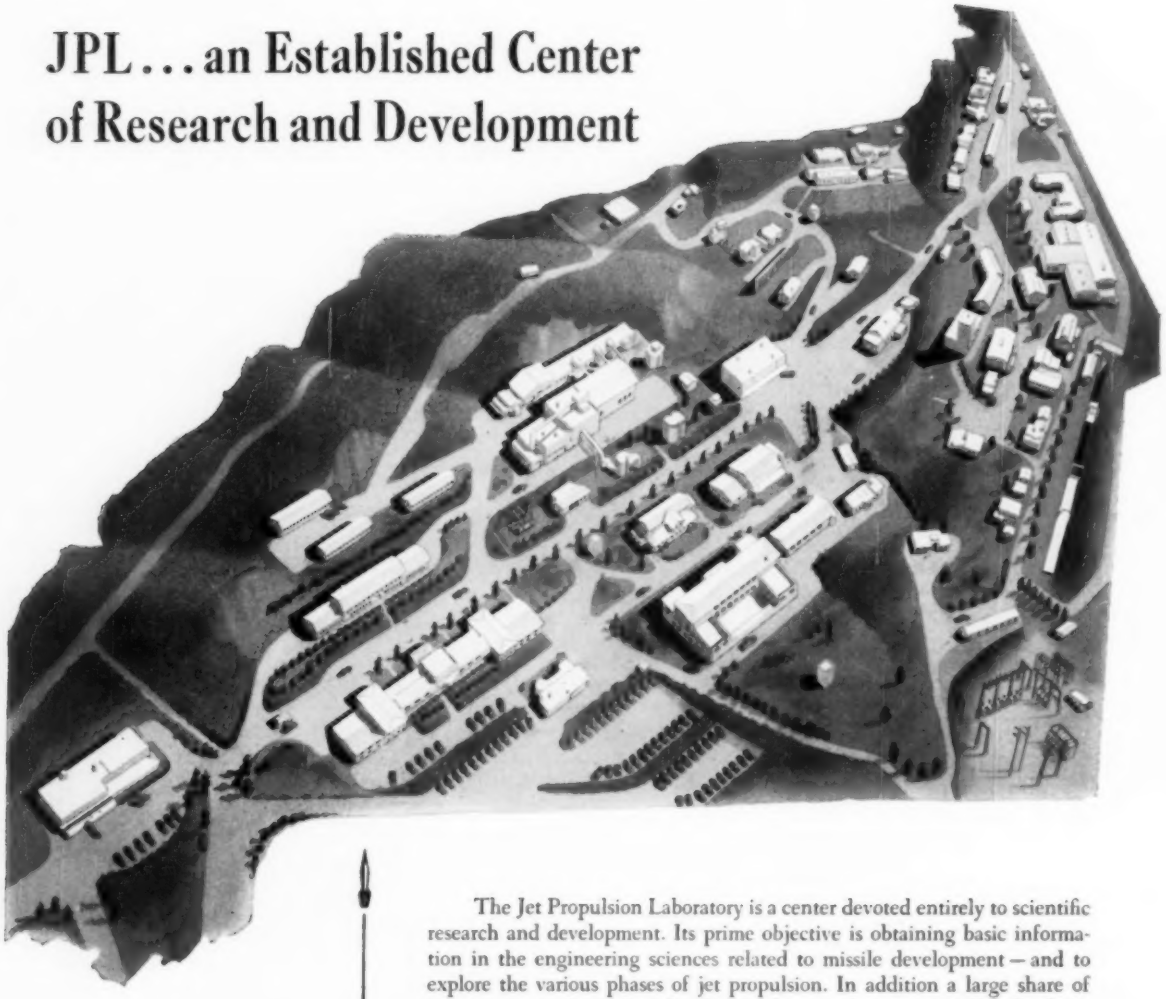
REAR cabin doors, are larger than usual.

FULLY cantilever seats allow great flexibility.

PYLONS have small no smoking and fasten seat belt signs, loud speaker from public address system, and individual emergency oxygen masks, reading lights, ventilators and call buttons for attendants.

FIVE-SEAT across arrangement. Main cabin has 98 seats upholstered in different colors.

JPL . . . an Established Center of Research and Development



★ At this time we are particularly interested in interviewing graduate engineers and scientists in the fields of aerodynamics, aircraft structures, mechanical engineering, chemistry, chemical engineering, heat transfer, electronics, systems analysis, electromechanical instrument design, instrumentation, metallurgy, nuclear physics and solid state physics.

These men should be definitely interested in scientific research and development relating to the problems of the future.

The Jet Propulsion Laboratory is a center devoted entirely to scientific research and development. Its prime objective is obtaining basic information in the engineering sciences related to missile development — and to explore the various phases of jet propulsion. In addition a large share of its program is devoted to fundamental research in practically all of the physical sciences.

The Laboratory extends over more than 80 acres in the foothills of the San Gabriel mountains north of Pasadena. It is staffed entirely by personnel employed by the California Institute of Technology and conducts its many projects under contracts with the U.S. Government.

Exceptional opportunity for original research coupled with ideal facilities and working conditions have naturally drawn scientists and engineers of a very high caliber. These men, working in harmony, are building a very effective task force for scientific attack on the problems of the future.

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PASADENA, CALIFORNIA

flexibility in seating arrangements may be made, allowing quick conversion from four- to five- to six-abreast interiors.

The cabin is provided with two sets of double seat tracks, each equi-distant from the cabin wall. If double seats are used, the aisle seat is attached to the track and the window seat is cantilevered from it.

There is no attachment between window seat and cabin wall.

The main cabin has 98 seats which are upholstered in alternating groups of blue-and-natural and brick-and-natural fabrics to introduce variety into the interior and minimize the length of the cabin.

Adjacent to the aft entrance are two additional lavatories, another five-seat lounge and a second galley. (Bulkheads separating forward and rear lounges may be quickly removed and ten additional seats added).

The forward galley demonstrates the type of equipment required for transcontinental service, with pre-set trays and casseroles. The aft galley is equipped to heat the kinds of precooked and refrigerated meals that are served on trans-ocean flights.

Mockup design and construction were under the direction of Frank Del Guidice, Seattle director for the Teague organization, working with Boeing engineers.

The Teague company, Boeing design consultants since 1946, spent 16,000 man hours on the mockup's design and 25,000 man hours on its construction. Over 1,000 major assemblies went into the project.

Honeycomb Core Trim

Metal honeycomb core is trimmed to suit airfoil shapes and in critical areas the cells are compressed (densified) to achieve higher strength at Glenn L. Martin by a machine which does the job quicker, more accurately and 50% cheaper. It consists of a table, a clamp, and an adjustable roller which is moved along tracks on the side of the table manually.

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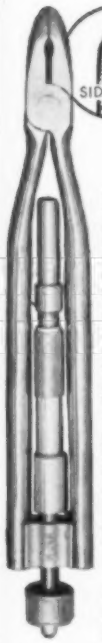

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WHAT'S NEW

New Publications

Stresses in Aircraft and Shell Structures—by Paul Kuhn—Pub. by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $14.00; 435 pp.

This book, an outgrowth of work done in the Structures Research Division of the National Advisory Committee for Aeronautics, is both a treatise for practicing engineers in the field of aircraft structures and a reference text for senior elective and graduate courses in the subject.

Proceedings of the Second Annual Computer Applications Symposium—Sponsored by Armour Research Foundation of Illinois Institute of Technology—Available from Armour Research Foundation, CAS:2, Technology Center, Chicago 16, Ill. $3.00 per copy (covers the cost of printing, mailing, and handling).

Covers applications of computers and data processing machines to business and management problems as well as to engineering and research problems.

Proceedings from Fifth Annual Ohio-Indiana Agricultural Aviation—Copies are available from the Ohio Aviation Board, 501 Wyandotte Bldg., Columbus, Ohio—(checks should be made payable to: Ohio State University Agricultural Aviation Conference Fund) $2.50 per copy.

Summaries of talks presented at this conference which was held at Ohio State University on February 22, 23 & 24, 1956.

Safety Through Steep Gradient Aircraft—by R. M. Woodham—Pub. by The Daniel & Florence Guggenheim Aviation Safety Center at Cornell University, 468 Fourth Ave., New York 16, N. Y.

Copies are available at 75¢ each, or $1.50 in combination with the 1955 Survey on "Safety Through Steep Gradient Aircraft" 43 pp.

Supplement to 1955 Survey reviewing status and special problems of vertical (VTOL) and short (STOL) take-off and landing types of aircraft.

Surveys in Mechanics: A Collection of Surveys of the present position of Research in some branches of Mechanics, written in Commemoration of the 70th Birthday of Geoffrey Ingram Taylor—Ed. by G. K. Batchelor and R. M. Davies—Pub. by Cambridge University Press, Bentley House, N.W. 1, London and available through Cambridge University Press, 32 East 57th Street, New York 22, N. Y. $9.50; 475 pp.

Creep and Fracture of Metals at High Temperatures: Proceedings of a Symposium held at the National Physical Laboratory 31st May-2nd June 1954—Pub. by Her Majesty's Stationery Office, London, and available in the U. S. from British Information Service, 30 Rockefeller Plaza, New York 20, N. Y. —$5.60 postpaid; 420 pp.

Contains 24 papers presented at a Symposium on the Creep and Fracture of Metals at High Temperatures which was held at the National Physical Laboratory, Teddington, Middlesex, England.

The papers are divided into four sections: deformation processes in simple materials, creep resistance of complex materials, theory of fracture, work on tertiary creep and fracture.

Roll Back the Sky—by Ward Taylor—Pub. by Henry Holt and Company, Inc., 383 Madison Ave., New York 17, N. Y. $3.95; 381 pp.

Author tells about the B-29 crews who flew the low-altitude fire-bomb missions over Japan during World War II.

European Productivity Agency Technical Digests—Available in the U. S. from the Organization for European Economic Cooperation, Missions Publica-

A letter from Daddy
TO: BETH McCARTER
Dear Beth:
No, I don't mind you flying around with that Mergatroid McSquirtle from next door, providing you take certain precautions. Airplanes are safe but I just don't trust McSquirtle. In case he lives up to his reputation as a ladies' man, you better always wear a parachute. Keep this letter in your chemise as a reminder: If worst comes to worst, make for the door like a scalded coon, curtsy coolly, and leap.
I also insist that, if you're going to ride in it, Mergy's plane be serviced by Southwest Airmotive. Tell him that all old business pilots have found it's really less expensive and a lot more sensible to go First Class. After 24 years, SAC has the know-how and equipment to do flying's finest job on engines, accessories, aircraft, props, instruments, refueling, and new-parts distribution.
And SAC has Experience! In the first half of '56 alone, 40 Southwest employees tallied up 300 years of total service there. No other comparable operator can make a statement like that about its workers.
Now, honey, you're NOT experienced, even if you are 21, 124 lbs., 5'6", hazel-eyed and red-haired. So w-a-t-c-h that Mergatroid McSquirtle!
Love, Daddy
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tions Office, 2000 P Street, N.W., Washington 6, D. C. $24.00 per year (12 issues), $12.00 per six months (six issues) $2.50 per single copy.

Digest of articles published in about a thousand European journals describing processes, methods, apparatus or materials which could be applied in industry to increase productivity. Intended primarily for engineers and technicians, rather than scientific staff.

USAF Aircraft: 1947-1956—by James C. Fahey—Published by Ships & Aircraft, Box 548, Falls Church, Va. 32 pp. $1.50.

An illustrated guide to U.S. Air Force and Army aircraft and missiles, detailing their procurement, characteristics and modifications. Continuing the previous U.S. Army Aircraft: 1908-1946, the volume provides a key for threading through the maze of aircraft purchases since World War II, also is a highly accurate and expert recognition guide.

World Aircraft Recognition Manual—by C. H. Gibbs-Smith and L. E. Bradford—Pub. by John de Graff, Inc., 31 East 10th St., New York 3, N. Y. $3.50; 269 pp.

A new approach to aircraft recognition and classification, in which aircraft are arranged under the general headings of delta-wing, swept-wing, straight-wing and rotary-wing. (Publication date: May 28, 1956)

Introduction to Plasticity—by Aris Phillips—Pub. by The Ronald Press Co., 15 East 26th St., New York 10, N. Y. $7.00; 229 pp., 270 illustrations, and 10 tables.

An introduction to the rapidly developing field of metal plasticity for the advanced undergraduate and graduate student of engineering and for the practicing engineer.

Telling the Market

Photo catalogue of **aircraft types** of all periods, booklet, Acroplane Photo Supply, Box 195, Toronto, Canada . . . **Guide of aerial photographic,** motion picture and photographic instrumentation equipment, Catalog 464, Gordon Enterprises, 5362 North Cahuenga Blvd., North Hollywood, Calif. . . . New material **specifications for investment cast parts,** Investment Casting Institute, 27 East Monroe St., Chicago 3, Ill.

Principles of **rescue and fire fighting** for civil aircraft, charts, National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. . . . Illustrated description and specifications of **automatic controls for aerodynamic testing** facilities, booklet MSP-133, Hagan Corp., Hagan Bldg, Pittsburgh 30, Pa.

ENGINEERING TIMETABLE

1:50 P.M. HOLDING THE CURVES

The curves, of course, are not on the highway, but on the oscilloscope. The men? Fairchild Guided Missiles Division engineers. The project? Testing advanced equipment for a new FGMD project.

Working from start to finish on their project *as a team,* these engineers typify the group spirit of engineering at Fairchild Guided Missiles Division. To bring problems to solutions faster, to speed progress in such fields as inertial guidance, passive guidance and radar, and many other projects, FGMD engineers pool their collective talents, experience and inventiveness. And, they see their work through from idea to success.

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Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

The dog-eat-dog battle for engineers within the industry has reached alarming proportions, a battle fought against the background of a fixed engineering manpower pool.

Nor does the vicious circle of pirating do the industry a whit of good. Sure, one company gains a small advantage when it hires a man away from another concern, but it leaves a vacancy that can only be filled when the second company lures an engineer away from a third plant.

The basic problem – the crying need for more engineers—is now recognized, but the industry is pursuing hit-and-miss solutions with one eye fixed fearfully on the astonishing growth of Russian technical capability.

Studies have been made, apprentice training organized, college and high school youths contacted, but the efforts so far have been ineffectual—sporadic and thin-spread – and the continuing, feverish attempts to capture rival plant personnel show in the "battle lineups" carried in the want-ad sections of the daily newspapers.

Engineer executives who face the problem squarely deplore the piracy, but declare that until the industry as a whole takes on the problem with a hard-hitting campaign, there's little else they can do.

"We have a fixed manpower pool in engineering," explains Ed Schmued, Northrop's engineering vice-president. "Those who come into engineering are just about balanced by those who leave it. Yet the problems we face in this jet-and-missile age are piling higher and higher every day."

Schmued, and other future-seeing executives like him, know well the growing technical menace posed by Russia. They know the Soviet "whip-and-candy" policy that forces designated young men to become engineers, a policy of high honor and monetary reward for success and down-the-drain fate for failure.

Cold statistics show that America's peak output of engineering graduates came in 1950 (swelled, of course, by GI students) when 50,000 young men entered the field. Since then the figure has slipped to roughly 20,000 per year. On the other hand the Soviet graduate total has jumped from 28,000 graduates in 1950 to 54,000 in 1955.

Some argue that although Russia has an elite corps of technical experts second to none, the Soviet system is perched on a shaky engineering base in that the USSR staffers have not yet acquired that degree of "engineering feeling" which only broad familiarity with machinery can bring – that they work by the book and require detailed direction.

But an analysis of Russian technical achievements since the end of World War II would seem to prove that the Red system, for whatever reason, is a decided success.

The consensus is that we are still ahead of Russia, but how long we can stay ahead without a boom in engineering is anyone's guess.

The answer apparently lies in several programs embracing a concerted effort by the industry to improve our educational system and to make more efficient use of the engineers we now have. It's certain that the merits of engineering, its honors and accomplishments must be impressed not only on students, but on parents of grade-school-level youngsters as well.

Here I should like to suggest that the dull, routine teaching of math be given serious study. In many instances a pupil is either frightened or bored with figures as taught today. Certainly, with proper presentation, the subject could be made intriguing, thus laying a firm groundwork for higher math and engineering success.

The program must not only point up the vast possibilities of engineering, with executive positions just a half-step away for experienced men, it must make home extension courses available to upgrade engineers now working. It must create better working conditions and urge better salaries, salaries commensurate with other professional levels. It must work to provide these men with full opportunity to use their skills and their aptitudes and assure honors for accomplishment.

Whittaker, essentially an engineering firm, recognizes the era of the engineer, an era that is here to stay, keynote in the vast, expanding challenge of speed and space. The valve company – as some do and others must – appreciates the vital role of engineering in the world of today and tomorrow. And it treats its engineers with the respect and the consideration they so well deserve.

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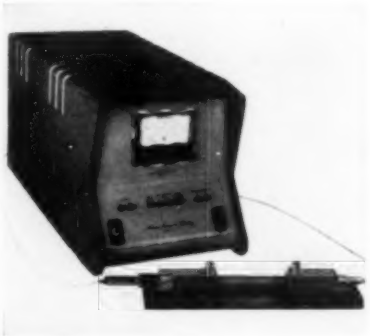
Noise Figure Indicator

Automatic noise figure indicator, Type 72, together with new Type 70 argon-discharge noise generator, continuously and directly indicate noise figure of a radio or radar receiver. This makes it possible to adjust or change receiver circuit, immediately note its affect on



performance. Noise generators come in two models: Type 70A can be used as a "white source" over range of 200 to 2,300 mc.; Type 70B is inserted at a shallow angle through a waveguide, comes in several versions to cover band of 2,600 to 26,000 mc.

Airborne Instruments Laboratory, Inc., Mineola, L. I., N. Y.

Vacuum Cleaner for Jet

Boeing Airplane Co. is using a specially built mobile vacuum cleaner to keep its flight aprons and other open areas clear of debris which might damage jet engines.

Called the JARC (Jet Airport Runway Cleaner), the truck-mounted unit develops energy equal to 1,200 household-type vacuum cleaners. The 16-ton machine has two 163-hp. gasoline engines which operate vacuum pumps connected by flexible tubing to nozzles. Material picked up falls into a separator, which can be emptied easily via large doors.

U. S. Hoffman Machinery Corp., Syracuse, N. Y.

Small Pumps for Short Life

Miniaturized oil-hydraulic pumps for limited life airborne applications can develop more than six horsepower per pound of total weight, when used at optimum system operating pressure and design maximum speed.

Their applications include missile hydraulic systems and for supplying emergency power in aircraft.

Typical of the new series is Model 3906, smallest of the line. It measures 2.5 in. long, 1⅛ in. in diameter and weighs less than one pound. With 15 deg. stroke angle, it is rated at 4.4 hp. and 2.5 gpm. flow at 12,000 rpm. with a system operating pressure of 3,000 psi.

Vickers, Inc., Box 302, Detroit 32, Mich.

Compound for Runway

Expansion joints in concrete runways used by jet aircraft are being filled with a tar-rubber SCCO compound resistant to oils, greases, gasolines and jet fuels.

SCCO is prepared by adding Chemigum Latex to tar; the Latex aids in uniform dispersal of rubber particles in tar.

Studebaker Chemical Co., Elyria, Ohio.

Oscilloscope

Memo-Scope 103, combines high quality oscilloscope with storage capability which forms and retains traces at constant intensity until deliberately erased. This feature permits study of transients with duration as short as 10 microseconds. Storage is accomplished

by a mesh immediately behind the viewing screen, which is charged by writing gun. Vertical amplifier sensitivity is 10 mv. d.c.; sweep speeds up to 100 seconds full scale are available.

Advanced Electronics Mfg. Corp., 2025 Pontius Ave., Los Angeles 25.

Airport Scale

Audio and visual signals are provided when passenger luggage exceeds the free limit on Series 600 scales.

Units come in heights from 29 in. to 44 in. Platform is stainless steel. The scales are available with roller platform.

Triner Scale & Manufacturing Co., 2716 W. 21 St., Chicago 8, Ill.

Unit Checks Autopilot

Self-contained mobile Scoba unit for testing automatic pilots in aircraft pro-

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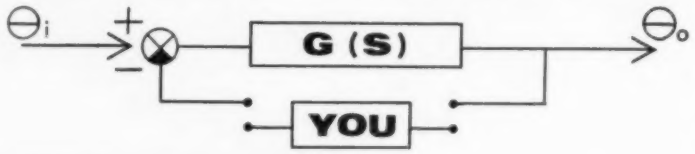

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MERCY MISSION . . .

Kaman's HOK-1 general utility helicopter, now in volume production, is designed to carry personnel, litter evacuees or cargo internally. Fitted out as a "flying crane" it can carry cargo slung externally. Equipped with a power hoist it can be used for search and rescue operations.

As a rescue vehicle the HOK got its baptism of fire in the disastrous New England floods of August 1955, and came through admirably. Kaman is proud of these mercy missions. Kaman is also proud of the part it is privileged to play in the continuing program of National Defense.

KAMAN

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vides independently controlled vacuum and hydraulic sources. The tester can also flush, decant, and replenish hydraulic systems, or can be used in shops for checking blind flying instruments, hydraulic components and the like.

Different types of vacuum pumps can be installed to suit particular aircraft. A warning light is activated when the unit is in use.

Aeroncontacts (Ground Equipment), Ltd., Horley, Surrey, England.

ALSO ON THE MARKET

"O" ring compound, 730-70, meets the requirements of high-temperature systems in sonic military aircraft operating with MIL-O-5606 hydraulic fluid. It meets MIL-P-18017B(ASG) and its predecessor specifications. Temperature range of −65F to +275F has been established.–Precision Rubber Products Corp., Dayton, Ohio.

High-flow shut-off valve features an unobstructed straight-through flow. Item has been used with liquid oxygen, jet fuels, high-pressure pneumatics and hydraulic fluids. Self-cleaning seat arrangement provides a bubble-tight seal under conditions of temperature from −320F to +350F. Available operating time range is from 0.030 sec to one second.–Hydromatics Inc., Cedar Grove, N. J.

Wunda-Vu water repellent, an air-curing, invisible resin for application on airplane windshields. A few drops normally last several weeks.–Wunda-Vu Products Co., 1522 So. Staples St., Corpus Christi, Tex.

High-speed syncroverter relay is designed for dry-circuit and low-power applications. Operation is unaffected during shock of 30G, and vibration (10-55 cps.) of 10G. Temperature range: −55C to +100C; contact ratings: up to 28 v, 200 ma. Pull-in time (including bounce): as low as 200 microseconds; drop-out time: 300 microseconds; stray contact capacitance: less than 15 mmfd.–Bristol Co., Waterbury 20, Conn.

Batch-type airless abrasive blast-cleaning machine is designed for removing sand, scale, oxides, and other contaminants from any work that can withstand a tumbling action. Operating load capacity is 28 cu. ft. Unit can be operated automatically or manually.–Wheelabrator Corp., Mishawaka, Ind.

Disogrin, a diisocyanate polyester elastomer, offers high tensile strength, extreme abrasion resistance characteristics, long life, and resistance to high ozone concentrations, oil and jet fuels, and

Motor cowl seal on Northrop F-89D is made of silicone rubber to assure efficient, maintenance-free service at extremes of temperature. Silastic has proved ideal for sealing all types of aircraft access openings.

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• Tear strength, lb/in	40 to 75
• Compression set, %, @ 300 F	25 to 50
• Hardness range, Durometer	20 to 80
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have declared, "battles
could be won or lost
on the radar-
scopes of our early-
warning planes...
and their mission
would change
from sentry duty
to that of combat
command post."

With each ominous technological advance in aerial warfare by potential aggressor nations, the maintenance of a round-the-clock early-warning system becomes increasingly vital. That's why the USAF's RC-121D and the U. S. Navy's WV-2 SUPER CONSTELLATION sister ships—distinguished by huge radomes atop and below the fuselage—have been flying day-night surveillance missions in all kinds of weather, around the calendar.

Carrying 6 tons of radar gear, these Lockheed SUPER CONSTELLATIONS are pressurized and air-conditioned to provide 75-degree cabin comfort, for a 31-man crew, when outside weather is minus 60. Powered by four Wright 3250-h.p. turbo-compound engines, these picket patrol veterans operate at altitudes over 25,000 feet, if necessary, and at speeds up to 300 mph.

Lockheed developed the antenna reflector assembly in the belly-radome. (From an altitude of 10,000 feet an RC-121D or WV-2 can radar-scan an area of 45,000 nautical square miles.)

Only Lockheed produces long-range early warning radar planes—a tribute to the SUPER CONSTELLATION'S famed dependability and to Lockheed's leadership in long-range patrol aviation.

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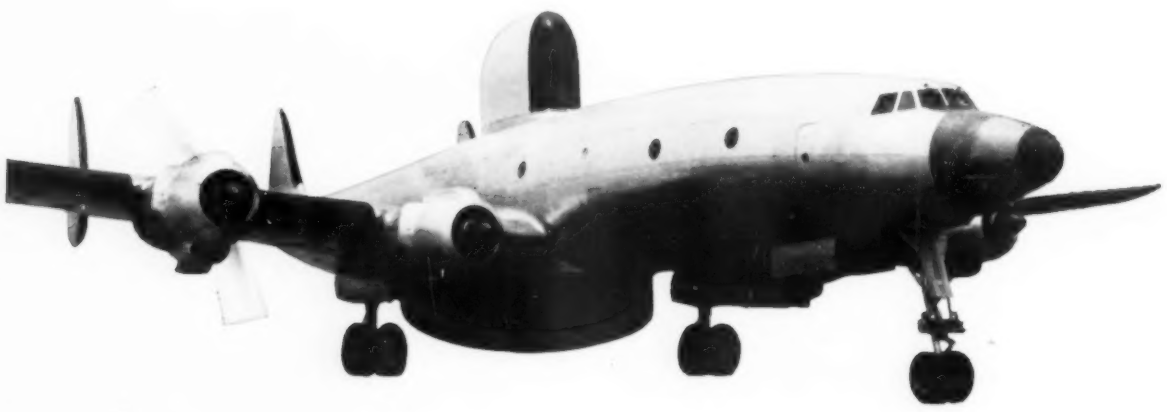

to radio-activity. Application for general use in hydraulics and mechanical fields, wherever sealing and abrasion are problems.–Greer Hydraulics, Inc., New York International Airport, Jamaica 30, N. Y.

Elapsed time calculator is a chronoscopic slide rule made up of a series of four numbered plastic discs graduated in size from 8 to four inches. Item computes travel time, serves as an aid to navigation, calculates logged flight time of aircraft frames and engines, and assists in flight crew scheduling. –George Lovelace, Pan American-Grace Airways, 135 E. 42 St., New York 17, N. Y.

Electromite, 3-wheeled electric car, has two speeds forward with a maximum of 20 mph; it runs on regular automotive-type batteries. Speed limit can be adjusted downward to six miles per hour. Built-in charger plugs into any 100-v. a.c. socket and automatic timer shuts off when charging cycle is completed. Maximum range approximately 36 mi. between charges.–Electromite, Inc., 16254 Meyers Rd., Detroit 35, Mich.

Experimental alignment interferometer measures changes in angle of arc to 0.000001 in. accuracy. It detects small changes in angle through a total range of 30 sec. of arc. Unit can be rested on its base, side, or end to measure the alignment of jigs, fixtures, or flat bed surfaces.–Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.

Step-function speed reductor combines versatility of a continuously variable speed drive with positive drive and exact repeatability of a geared unit. Any one of eight different speed ratios may be dialed without stopping the input drive shaft. Unit has torque capacity in excess of 30 oz.-in. and is recommended for input speeds up to 500 rpm.–Insco Co., Division of Barry Controls, Inc., Groton, Mass.

Aluminum rivet cooler with 50 canister capacity features a non-electrical mechanical safety locking device. Locking device has patented feature so designed that if temperature rises to −20 F lid is automatically locked, ad a key is required for release. Unit is equipped with temperature control mounted in unit compartment having a range from 0 F to −50 F; also, temperature indicator with flush mounted indicating thermometer with temperature range from +120 F to −50 F.–Webber Engineering Corp., Dept. ARC-364, P. O. Box 217, Indianapolis 6, Ind.

Model A-8, accelerometer of variable reluctance type, is designed for flight test application. Unit allows measurement of accelerations from static to vibration frequencies as high as 1000 cps for 300 g instrument. Model is available in ranges from ±5 to ±300 g. Output is 40 mv/v input for full scale input and accuracy is better than 1 percent under constant ambient conditions.–North American Instruments, Inc., 2420 N. Lake Ave., Altadena, Calif.

Model 150A 10 mc oscilloscope magnifies 100 times; dc to 500 KC horizontal amplifier provides sweep magnifications of X1, X5, X10, X50, and X100. Full sweep range is .02 μsec/cm to 15 sec/cm. Triggering may be internal, external, or from line voltage on positive or negative level and slope.–Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif.

Pressure-tight squibs, igniters, and explosive packs are arranged to be threaded directly into any high-temperature pressure chamber. Units include 13 types ranging from ¼ in. to 1 in. diameter thread size. Electrical lead is hermetically sealed through threaded case with a pressure-stressed ceramic seal having an insulation resistance in excess of 10,000 megohms.–McCormick Selph Associates, 25 Hollister Airport, Hollister, Calif.

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Dutch Build Ram Jet Helicopter For Two

The Dutch expect to be delivering production versions of this 2 passenger ram-jet helicopter early in 1957. Nederlandse Helicopter Industrie (NHI), Overschie, Holland, claims that their 440 pound, 62 mph. cruising speed, H-3 production model will cost but one-third to one-fourth of the amount for a conventional helicopter.

The prototype is fitted with two 55-hp. ramjets developed by NHI. They are designed to burn household kerosene, but also are capable of using gasoline or jet fuels.

According to reports, the craft has proven stable with fine flying characteristics. Engine-off landings have been accomplished without difficulty and maneuverability has proven good.

NHI claims operational costs of the aircraft will be half and maintenance extremely easy in that there are no moving parts in the engines and no clutches or heavy transmissions.

Commercially the best endurance is under a half-hour. One-hour flights may be carried out for military observation and liaison duties. MHI also is developing spraying equipment and a roadable heliport for long-range transportation which is expected to be available this year.

Supersonic Load, Heat Simulated in Tests

Full-scale missile components are being tested under loads and temperatures simulating those of high supersonic flight at a new facility at McDonnell Aircraft Corp.

A typical component as big as 15 ft. long and 3 ft. diameter can be tested at temperatures up to 1,000F; smaller units can be subjected to as high as 1,500F. Design heating rate is 15F per second.

The new facility uses a radiant heating system with quartz lamps and heat reflectors. Flexibility of the installation comes from moving the lamps with respect to the specimen and from varying the number of lamps.

Feasibility tests were run on the heating plant to check out equipment, instrumentation and operation. First runs were on a Talos missile wing and fin, built by McDonnell as part of the overall Talos program sponsored by Navy's Bureau of Ordnance.

Camera Spans Full Sky For Cloud Cover Study

A full-sky recording camera designed for the Air Force Missile Test Center is providing a detailed study of cloud coverage and how it develops during a day.

Information from the recording camera is useful in supplying basic data on the atmospheric conditions for photographic and optical coverage of missile flights.

The camera was built by the Optics Engineering Laboratory of Radio Corp. of America, which operates the range jointly with Pan American World Airways. Heart of the unit is the Beattie Varitron pulse camera which takes a picture every 15 min. through the day. The picture is of the full sky as reflected on the surface of a 12-in. glass sphere.

Advance Study Offered To Engineering Employes

Kaman Aircraft Corp. employes who are qualified now may do graduate study at Rensselaer Polytechnic Institute's Hartford Graduate Center in a plan arranged by the corporation and RPI.

Employes with a bachelor's degree in engineering who can meet the requirements for the graduate center will be eligible after three months of service at Kaman.

Company will pay the tuition in full in three installments: On enrollment, on completing the course and on award of the master's degree. Courses are held in the evening.

'no sweat' when the 'heat's on'!

HYPER-SENSITIVE INFRARED SYSTEMS are part of a highly active research program at Texas Instruments. Basic investigation into crystalline optical materials puts TI at the forefront in development of infrared systems and techniques.

INFRARED APPLICATION is just one outstanding aspect of Texas Instruments *systems engineering* abilities. TI's Apparatus Division is also producing transistorized military equipment with size and weight reductions as high as 100 to 1! For airborne installations in particular, this miniaturization design approach means greater reliability, larger pay loads, longer ranges, and deeper penetration for more positive results.

FOR WELL OVER A DECADE, Texas Instruments has been building radar, sonar, and other systems for search, communications, navigation, missile guidance, and fire control... frequently to accelerated delivery requirements. Facilities for continuing progress in *systems engineering* and manufacture include over a third of a million sq ft of plant space in an excellent dispersal area.

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Turcoat 4178 works on the surface conversion principle... that is, the coating is partially derived from the metal itself. Thus, coating and metal are *firmly interlocked*... even in tiniest crevices. The coating is a light golden color that imparts a special beauty when used for decorative purposes.

One user reports that square footage processed has *doubled* since the installation of Turcoat 4178. Key to this speed is the manner in which the coating "sets" and becomes non-smearing immediately. Drying is unnecessary. Parts can be further processed *without any delay in production!* Moreover, the coating is *uniform*. There are no light, tell-tale untreated sections around welds, corners or holes.

The Turcoat 4178 Coating becomes non-smearing immediately upon withdrawal from processing. Drying is unnecessary. Parts can be handled freely while still wet without danger of smearing or streaking coating.

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Monoxide, Hypoxia Traced in Crashes

Hypoxia and exposure to carbon monoxide have been determined to be a major cause of unexplained accidents by examination of body tissues in post-mortems.

Hypoxia—lack of oxygen—is determined by measuring the concentration of lactic acid in the brain tissues.

In 37 crash cases where brain tissue was available for study, 11 of the examinations showed indication of hypoxia.

Carbon monoxide is measured directly as a concentration in the tissues. Of 91 cases so studied, 43 had blood carbon monoxide values above a dangerous level.

Studies were reported by Robert T. Clark, Jr., S. S. Wilks and Donald Van Fossan of USAF's School of Aviation Medicine.

Certificates of Necessity

General Motors Corp. has been awarded a $13,955,151 certificate of necessity for rapid tax amortization by the Office of Defense Mobilization. The facility is for research and development. Of the total amount, 50% is allowed for accelerated tax amortization.

Other recent certificates include:

Northrop Aircraft, Inc., Hawthorne, Calif., military aircraft, $200,000 certified with 60% allowed; military aircraft and parts, $370,200 certified with 65% allowed.

Lockheed Aircraft Corp., Marietta, Ga., military aircraft and parts, $1,953,057 certified with 65% allowed; Burbank, Calif., military aircraft, $1,650,000 certified with 60% allowed; Burbank, Calif., military aircraft, $361,431 certified with 65% allowed.

United Aircraft Corp., East Hartford, Conn., military aircraft engines, $4,448,000 certified with 60% allowed; Hamilton Standard Div., Windsor Locks, Conn., military aircraft parts, $266,814 certified with 65% allowed; Hamilton Standard Div., Windsor Locks, Conn., military aircraft parts, $460,900 certified with 65% allowed.

Ex-Cell-O Corp., Elwood, Ind., aircraft engine parts, $350,739 certified with 45% allowed.

Fairchild Engine and Airplane Corp., Hagerstown, Md., military aircraft and components, $108,291 certified with 65% allowed.

Bendix Products Div., Bendix Aviation Corp., South Bend, Ind., military aircraft components, $1,121,930 certified with 40% allowed.

Cambridge Thermionic Corp., Cambridge, Mass., electronic parts, $21,925 certified with 70% allowed.

A. Finki & Son Co., Chicago, Ill., large die blocks for military aircraft production, $226,950 certified with 70% allowed.

Joseph H. Thibodeau and Lester M. Laing d/b/a La Deau Mfg. Co., Los Angeles, Calif., aircraft parts, $28,000 certified with 45% allowed.

Avica Corp., Middletown, R. I., military aircraft parts, $100,000 certified with 45% allowed; $4,000 certified with 70% allowed.

Goodyear Aircraft Corp., Akron, Ohio, aircraft components, $149,002 certified with 60% allowed.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

SAN ANTONIO AIR MATERIEL AREA, Kelly AFB, Texas.

The B. F. Goodrich Co., Akron, Ohio, 1AHC-11-270-9-1 Boot-190 ea., 1AHC-12-270-8-1 Bood, 233 ea., 1AHC-12-270-8-2 bott, 125 ea., Contract Nr: AF 41(608)-7794 (Purchase Request: SA-723277 and SA-723277-1, 2nd Final), $60,378.

DAYTON AIR FORCE DEPOT, Gentile Air Force Station, Dayton 10, Ohio.

North American Aviation, Inc., 4950 E. Triggs St., Los Angeles 22, Calif., signal data reproducers, type No. RP-106/GPH, contractor's part number and dwg number 10080-307, 11 ea., (RFP 33-604-56-1160), $154,000.

Borg-Warner Corp., Byron Jackson Div., Electronics, 492 E. Union St., Pasadena, Calif., signal generators AN/USM-16 USAF stock number 7CAC-363957, 227 ea., (PR's GE-609242 and GE-609242-1), $851,887.

HEADQUARTERS AMC, Wright-Patterson AFB, Ohio.

Bendix Aviation Corp., Pioneer-Central Div., Davenport, Iowa, transmitter, rate of fuel, type J-6A, (PR 635848), 3285 ea., $831,072.

Cosmas Industries Inc., 31-28 Queens Blvd., Long Island City, N. Y., indicator, D-314/APH-96, 813 ea., control C-917/APA-90, 770 ea., relay, RE-111/APA-90, 700 ea., (673719), $153,946.

Erco Div., ACF Industries, Inc., Riverdale, Md., domestic installation services for MB-9A and MB-2 flight simulators, (PR PD-141238), $27,958.

American Bosch Arma Corp., Garden City, N. Y., facilities for the production of MD-9 fire control systems for B-52 aircraft, (PR 670590), $190,000.

New Process Gear Corp., Syracuse, N. Y., acquisition and installation of machinery and equipment, (PR 636469), $51,000.

Alloy Engineering and Casting Co., Champaign, Ill., facilities for alloy research and development, (PR 671033), $190,500.

Glenn L. Martin Co., Denver, Colo., facilities in support of the WS-107A program, (PR 669603), $200,000.

Glenn L. Martin Co., Denver, Colo., facilities in support of the WS-107A program, (PR 669603), $300,000.

Beech Aircraft Corp., 9709 E. Central Ave., Wichita 1, Kans., first articles, 4 ea., test and test reports, lot, type MA-3, Multipurpose servicing units-ground towings, air start, electric and air servicing for RB66 aircraft support, (PR 154386 and Amend., 1, 2, 3 and 4), $4,303,041.

General Electric Co., AGTD, 1 Jimson Rd., Cincinnati 15, Ohio, accelerated amortization, (MIPR 639-52-21, Amend. 3 MIPR 2654-52-14, Amend. 12), $68,173.

Kollsman Instrument Corp., 80-08-45th St., Elmhurst 73, N. Y., spare parts for item 2 computers, type C-2A, (PR PE 207210), $48,553.

Chicago Aerial Industries, Inc., 1980 N. Hawthorne Ave., Melrose Park, Ill., detector, type LA-19, 114 ea., converter, type LA-20, 92 ea., (PR MO 664057, EC-A 636256, EC-A 636263 and EC-A 636264), $109,070.

Motorola, Inc., 2710 N. Clybourn, Chicago, Ill., antenna AS-360/APS-23, 148 ea., comparator CM-24/APS-27, 91 ea., receiver-transmitter, RT-286/APS-27, 153 ea., (PR 709802 and 709815), $1,200,000.

The Geotechnical Corp., 3712 Haggar Dr., P.O. Box 7166, Dallas 9, Texas, projector, vertical reflecting, 7 ea., data, 1 lot, (PR 600067), $30,530.

Hoffman Laboratories, Inc., 3761 S. Hill St., Los Angeles 7, Calif., computer, latitude & longitude, CP-188A/ASN-6, 518 ea., amplifier, electronic control, AM-916/ASN-6, 380 ea., indicators, latitude and longitude, ID-389/ASN-6, 529 ea., (PR PE 168015), $3,106,043.

Hycon Mfg. Co., 2961 E. Colorado St., Pasadena, Calif., type K-46 camera, 385 ea., spare parts, maintenance tools & data, (PR 152721 and 671404), $681,450.

The Goodyear Tire & Rubber Co., Inc., 1144 East Market Street, Akron 16, Ohio, brake assemblies, 1556 ea., wheel assemblies, 1459 ea., wheel assemblies, 8 ea., (PR 671328), $551,636.

Fairchild Camera & Instrument Corp., Robbins Lane, Syosset, L.I., N. Y., C-1 Flash detector (UCCS), 22 ea., (PR MO-570095 and MO 570056-3), $38,153.

Suffolk Products Corp., Woodbine & Scudder Ave., Northport, N. Y., keyer, ARA-26, 909 ea., (PR PE 158727, MIPR 56-734-12-AER and Amend. No. 1), $127,820.

General Electric Co., West Lynn, Mass., thermocouple assembly, 6119-8943630-G14, 16250 ea., thermocouple assembly, 6119-8940799-G5, 9775 ea., (PR 598563 and 598563-1), $283,831.

Friden Calculating Machine Co., Inc., 2350 Washington Ave., San Leandro, Calif., driftmeters, type B-6A, electrically driven, 167 ea., (RFP PE 635964, R-56-1276-101), $496,825.

Contract Goes to Cessna for YH-41 Helicopters

Wichita—A letter of contract for the YH-41 helicopter calls for delivery by Cessna Aircraft company to begin in mid-1957 and to continue on a monthly basis thereafter. The helicopters are for the Army, but the contract was from the Air Force, the procuring agency.

The initial order is for an evaluation quantity, Dwane L. Wallace, Cessna president said, but tooling is to be sufficient for long-range production. The YH-41 is the Army designation for the CH-1 helicopter developed by Cessna.

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Business Pilots Want More Data Faster

By Erwin J. Bulban

New York—Need for a central clearing house to quickly disseminate among business pilots information relating to the operational, equipment and safety phases of their profession was highlighted at Flight Safety Foundation's recent two-day business aircraft seminar in this city.

Pilots attending the sessions generally agreed that government and industry have fallen behind in supplying them with critically needed services and data. The nature of their own highly individualized operations tends to restrict even word-of-mouth transmission of vital information.

Flight Safety Foundation's business aircraft safety program, organized as a result of early business pilot interest in developing a single-source of data (AW Sept. 12, 1955, p. 83), is making successful headway on this major problem; it now has over 100 corporate dues-paying members compared to 30 shortly after it was formed about a year ago.

Finance Problem

Although it has achieved considerable success in developing a data collection and dissemination program, there are many improvements it would like to make. Finances still apply a brake to its development. The organization won't talk about its problems in this regard, but it is believed that the business aircraft service function has a deficit of about 20% annually.

Inability of the U.S. Weather Bureau to keep its services growing in pace with the rapid development of business flying helps spotlight one major corporate pilot problem.

George F. Brewster, in charge of the inspection program in the Office of the Chief of the Weather Bureau, candidly admitted that services have been unable to keep pace with the demand. He touched on several new studies being made by the Bureau to speed up data transmission:

• **Development** of an electronic controlled plastic weather map hooked up to centrally-located teletypes that would automatically plot weather changes and conditions by lighting up different color flags indicating presence of fog, hail, rain, etc. He noted that the Bureau is looking for good ideas from the electronics industry in developing this for nationwide application.

• **Hookup** of transmissometer to a teletype so that airport visibility information is automatically sent over the wires is under development at Joliet, Ill. Next step is to hook-up a ceilometer to the teletype to provide both types of data.

• **Development** of a teletype machine capable of sending out twice as many words as the current rate of approximately 60 per minute is in the works.

Brewster noted that one of the most urgently sought bits of weather data is information on the altitudes of cloud bases and tops. He urged pilots to note these when they are flying and report data to weather people, along with any severe or unusual weather, including turbulence, ice and other hazards.

The Bureau will make it mandatory Aug. 1 for its weather observers to get data on cloud tops by calling the airlines and other sources for reporting to pilots.

Pilots at the meeting commented that they had tried getting weather in flight by calling Flight Advisory Weather Service, but by the time they got their information they had traveled so far they no longer needed it. Brewster advised they call Interstate Airways Communications Stations (INSAC), which have direct phone connections to FAWS stations and they will get the data for transmission to the pilot.

Brewster also noted that pilots check the new CAA Flight Information Manual coming out July 1 for Weather Bureau unlisted phone numbers. Pilots commented that they had been trying to get the LaGuardia station unsuccessfully, and Brewster replied that the station had been transferred to Idlewild and has a new unlisted number: OLympia 6-5364.

He told the pilots that they should be sure they get a complete briefing from weather people. Some briefers are new he pointed out, and they may not give complete data. He said it was a good idea for the pilot planning a long trip to call the briefer about 12 hours ahead of time, and give him the details. This will generally give him time to work up more detailed data, Brewster said.

Regarding a number of complaints about Bureau personnel, he admitted that there were problems in getting good men for every spot. "There are four or five stations in the U.S. that I have to hit every four or five months for a talk with personnel where I try to get their thinking up to date and convince them that airplanes are here to stay," he said.

Indications are that a trend may develop in corporations setting up their own aviation weather advisory services. Several corporation pilots stated that they are negotiating with private weather forecasting facilities to serve them. In some cases several corporations operating airplanes in one area plan to split the costs.

Traffic Control

Confidence that Edward P. Curtis, special assistant to President Eisenhower for aviation facilities planning, will work out a traffic control plan to unsnarl

Chilean Air Force Trainer

Fifty of these Chilean-designed-and-built Chincol primary trainers have been ordered by Chile's air force. Powered by a 215-hp. Continental engine, the Chincol is of mixed tubular, fabric and wood construction. It spans 34.11 ft., weighs 2,310 lb. fully loaded and 1,628 lb. empty. Cruise speed is 115 mph. The Chincol can clear a 50-ft. obstacle on takeoff in under 800 ft. It is manufactured by Fabrica Nacional de Aeronaves, Santiago, a national aircraft facility, which is also working on a jet-powered trainer.

Business Jet Transport Market Stirs

New York—A number of U. S. corporations are in the market for turboprop and jet-powered business transports and are discussing performance, availability and prices with several manufacturers, Aviation Week has learned from industry sources. Under consideration are:

• Fokker Friendship turboprop, to be built under license in the U. S. by Fairchild Engine & Airplane Corp., Hagerstown, Md. Ten corporations are talking to Fairchild about the Friendship, a half-dozen as far as the stage of delivery dates and prices. A few would be multiple orders. Johns-Manville is scheduling a Friendship delivery early in 1958. The airplane would have Rolls-Royce Dart RDa. 8 engines and long-range capability for coast-to-coast hops. Another interested prospect is Landis Tool Co.

• English Electric Canberra, twin-jet bomber. Two or three corporations are studying this airplane and one is about ready to talk over its release with the British government. An industry observer with wide contacts among corporation pilots said that if USAF were to make Martin B-57s available for civilian purchase, there would be 20 operating in about a year.

present conditions was expressed by Sam Saint, former technical consultant to Air Navigation & Development Board and now with Air Transport Assn.

He stated that the problem in the past has been that too many committees working simultaneously resulted in final recommendations being watered down to a common denominator to keep everybody happy, preventing the bold approach needed.

Automation Task

Saint emphasized that the immediate problem was to put automation techniques to work as fast as possible on the equipment now available, easing sore spots at congested areas and allowing higher utilization of available traffic area and runways. He said we now have the capability of putting an airplane "over the fence" and onto the runway within plus and minus seconds of when it should be there, in clear or bad weather. Present equipment could permit up to 60 landings and takeoffs per hour of mixed equipment per dual runways, such as those in operation at Chicago's Midway Airport, he said.

Discussions over the relative merits of X-band over C-band airborne weather radars brought out the opinion that

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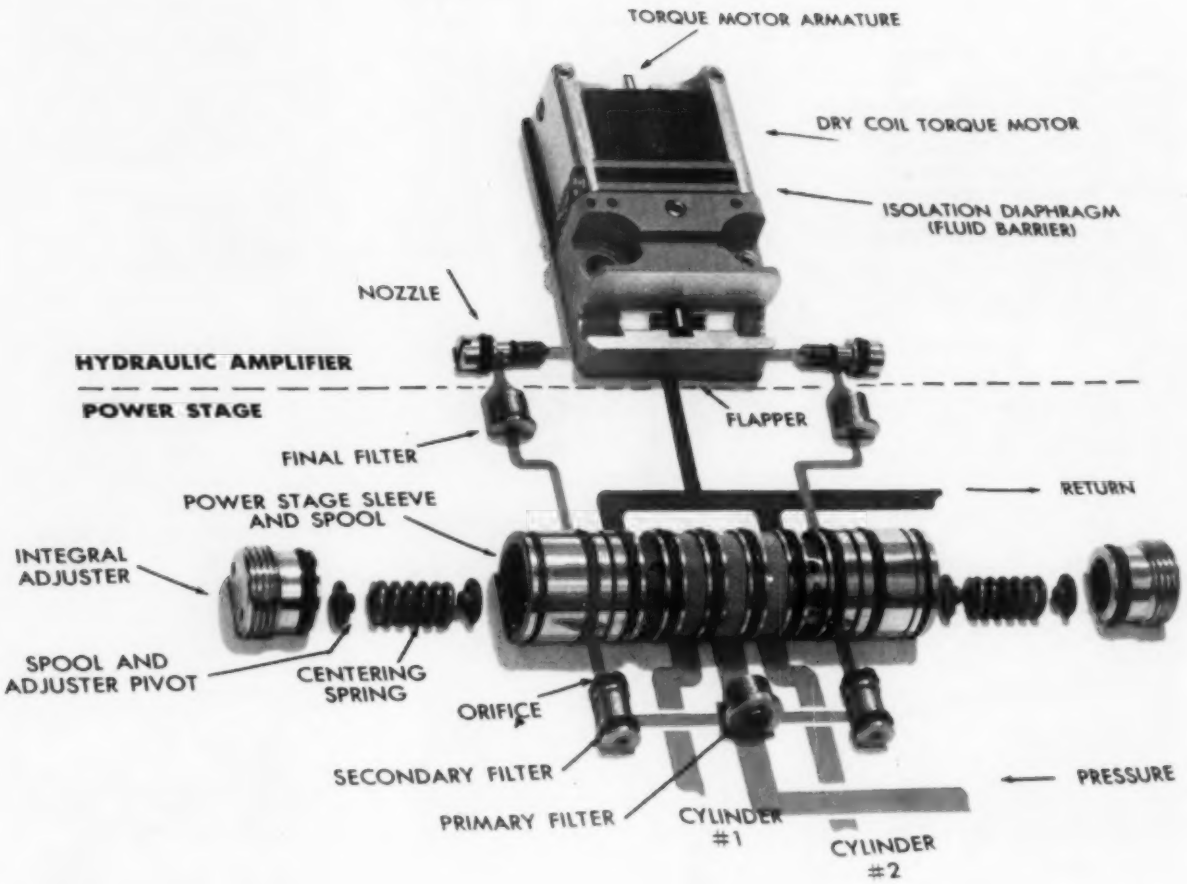

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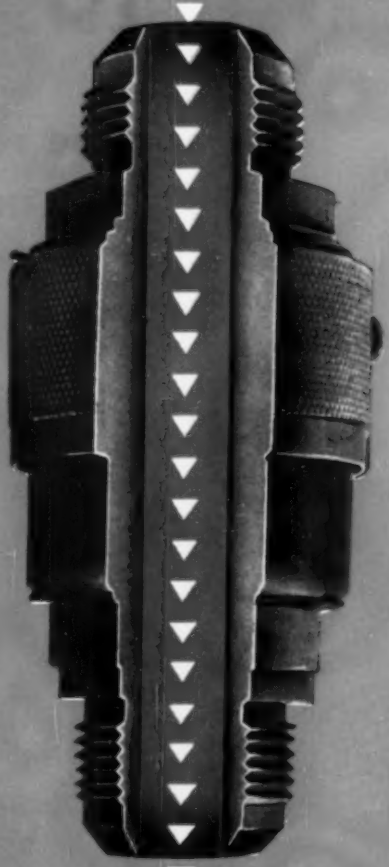

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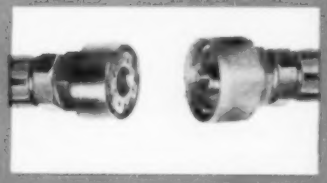

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for all intents and purposes, X-band is the preferable type. Main reason: X-band allows use of the numerous military ground radar beacons in the U.S. for position fixing; it also has better ground mapping facility because of its squared beam.

Pilots showed interest in the training aids developed by the airlines for their crews using radar. One of the most comprehensive booklets on this procedure is put out by United Air Lines as Meteorological Circular 39. Flight Safety Foundation plans to get sufficient copies for distribution among its corporate members.

Pilots with X-band equipment, interested in using the military ground beacons for position fixes can get the locations of the stations by obtaining Bulletin H.O. 520 from the U.S. Government Printing Office, Washington, D. C.

Cost is 50 cents annually.

Positioning of the radar scope in the cockpit is generally a difficult problem. The pilots were shown photos of Trans World Airline's installation in the cockpits of its 1049G Super Constellations: a retractable scope mounted between the pilots. It folds into the floor when not wanted.

Approximately 110-115 airborne radars, mostly X-band units, are now installed in corporation aircraft. They are credited with easing the pilots workload when flying in bad weather by showing spots to avoid sufficiently in advance to minimize detours; they also tend to lessen air-to-ground communications in bad weather.

Transland Starts Ag-2 Dealer Franchising

A factory-franchised dealership program has been started by Transland Co., Torrance, Calif., to handle sales of its new Ag-2 agricultural airplane, scheduled to make its first flight next month.

The low-wing all-metal airplane, powered by a 450-hp. P&W R985, is designed to carry a payload exceeding 2,000 lb. Chemical loads can be either all dust in a 53-cu.-ft. fuselage hopper or 250-gal. of liquid in wing tanks, or combinations.

Two Ag-2s will be tested simultaneously to qualify for CAA Part 3 and static trials. This program is expected to speed certification and deliveries.

Surplus Northrop Trimotor To Fly Mexican Lumber

A former USAF surplus trimotor Northrop C-125 Raider transport will be used by a Mexican lumber mill operator to carry heavy loads to and from a 4,500-ft. improvised landing strip built at 8,500 ft. on a mountain.

Triplay Y Maderas, Durango, will fly 10,000 lb. of lumber from the mills on each flight; the C-125 will haul 14,000 lb. of machinery, fuel oil and supplies on return trips. The flights will take 30 min., compared to several days by surface transport.

The plane is one of 18 modified by their present owner, Frank Ambrose Aviation Co., Miami, Fla. Their 1,200-hp. Wright R1820-99 engines were replaced with 1,350-hp. R1820-56s.

Pilotless Navions Test Remote Cameras

Remote-control aerial photographic and television surveillance equipment will be tested by U. S. Army Signal Corps using a drone system developed by Temco Aircraft Corp., Dallas. Initial units of the complete system have been delivered to Ft. Monmouth, N. J., and Ft. Huachua, Ariz. The project is built around six modified North American QL-17A Navions with 42-lb. remote control autopilots operated by off-on radio signals and 250-lb. ground control stations that can be transported in Jeeps. Ground control switches permit out-of-sight command of the Navions, signaling programmed maneuvers.

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WATER FLIES as Stinson Voyager test plane takes off from rough ground at Akron, Ohio.

'Barrel' Tires Get Rough Field Test

Barrel-shaped thin-sidewall tires designed to operate at three-to-eight-pounds per square inch air pressures are being tested by Goodyear's Aviation Products Division to increase the rough field capabilities of small planes. Compare (photo, right) the new 24-in.-wide Terra-Tire with a standard 6.00x6 tire normally used on a Stinson Voyager.

Goodyear is currently evaluating the new landing gear at Akron Municipal Airport, Ohio.

Already used by automotive vehicles, the new Terra-Tires' pliable sidewalls and low pressures enable them to absorb or conform to uneven surfaces, lessening the danger of sudden swerves. Their wide tread is designed to glide over soft surfaces.

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PRIVATE LINES

Use of a helicopter to attract attention to Wheelabrator Corp. display at Atlantic City foundry show recently suggests a way for rotary wing aircraft operators to put idle helicopters to work on charter during similar events in their locales. Bell 47 chartered by Wheelabrator had company's name painted on the side, used a temporary heliport on the beach and carried lucky ticket-holders over the city as prizes offered at firm's display.

Abitibi Power & Paper Co., Ltd., Toronto, Canada, acquired a DC-3 business plane from Remmert-Werner, Inc., St. Louis. Seating 16, the plane has Bendix X-Band weather radar.

Royal Gull appointments: Gulf Aircraft Sales, Houston, Tex., and Marine Aircraft, Inc., Detroit, Mich., will handle sales of twin-engine business amphibian for Royal Aircraft Corp., Milwaukee.

Lund Aviation, Inc., New York City, is a distributor for commercial Aerojet-General 15KS-1000 smokeless assist takeoff rocket units. An increasing number of these are being installed on multi-engine business planes (AW Nov. 28, 1955, p. 60) to increase safety in event engine fails on takeoff or to aid operations from small airports.

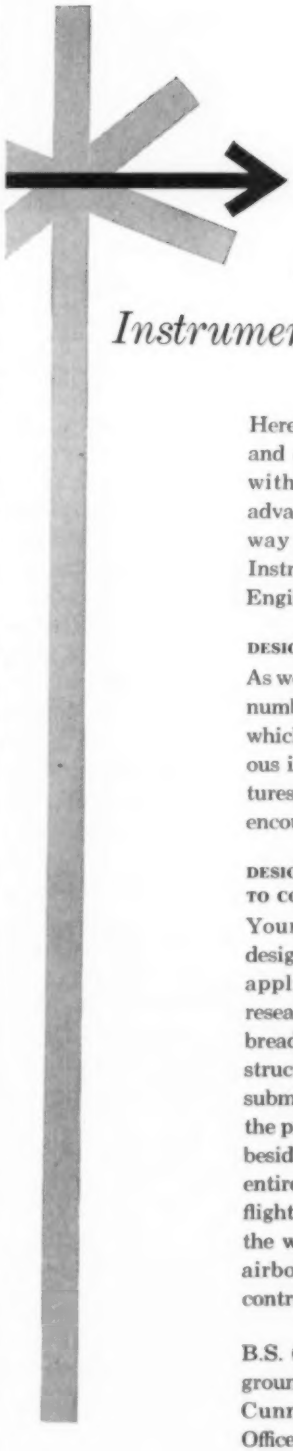
Airwork (New Zealand) Ltd., Christ Church, Piper distributor, has taken delivery of 21 aircraft thus far this year of all models. It has 14 more Pipers on order, all PA-18 Super Cubs.

A 50,000-sq.-ft. aircraft shop, first major segment of Southwest Airmotive Corp.'s $2 million expansion, is operating at Love Field, Dallas, Tex.

A $3.5 million contract for aerial mapping of 19 railway stations and track in British Railways southern & eastern regions has been granted Air Survey Co., Ltd., a subsidiary of Fairey Aviation Co., Ltd. Railways plan to install new equipment and need accurate maps for planning layouts.

Schrafft's has entered the airport field with opening of a restaurant and bar at Westchester County Airport. Facility provides full meals to snacks, also prepare in-flight lunches.

Cleanup tip: Safe Flight Instrument Corp., reports that it has taken up to 60 lb. of dirt out of its DC-3 business plane during cleaning interior and exterior.



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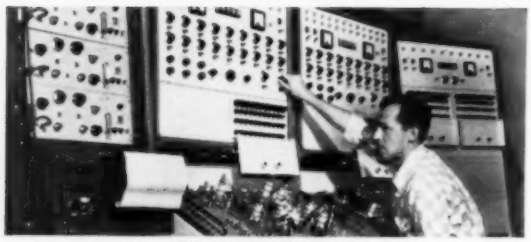
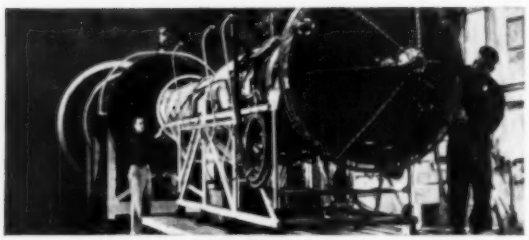


Electronics Systems



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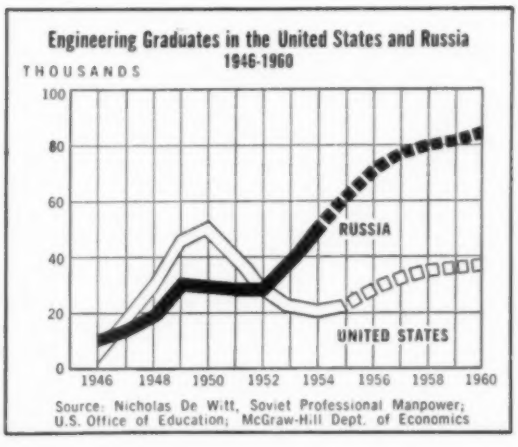
THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

Are We Losing the Race with Russia?

THERE is new confidence in the Kremlin. One key reason is expressed in a recent boast of Communist Party Secretary Khrushchev: **"The capitalists always regard our people as being backward, but today we have more engineers and more supporting engineering technical personnel than any capitalist country."** He promised that this lead would be widened and that communism would be victorious without war.

This boast cannot be dismissed as communist propaganda. Admiral Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, has warned: **"In five years our lead in the training of scientists and engineers may be wiped out, and in ten years we could be hopelessly outstripped. Unless immediate steps are taken to correct it, a situation, already dangerous, within less than a decade could become disastrous."**



This second editorial in a series on the shortage of scientists and engineers is designed to explore as carefully as possible the facts and the implications of the new emphasis on technical training in the Soviet Union. It draws heavily from the authoritative book *Soviet Professional Manpower,* prepared for the National Academy of Sciences and the National Research Council by Nicholas DeWitt of the Russian Research Center of Harvard and released recently by the National Science Foundation.

Trend Is Against Us

If the Soviet Union already has a lead in technical manpower, it is not very great. Both the United States and Russia now have around a million scientists and engineers. About a third of the Russian engineers were trained on inferior pre-1935 standards. **It's the trend — shown in the chart — that is alarming.**

Over the last five years we have turned out only 142,000 engineers, compared to an estimated 216,000 in Russia. In 1955 our output was around 23,000 compared to their 63,000. Over the next five years our projected output is 153,000, against at least 400,000 in Russia. There will be an additional 150,000 or more in the satellites and Red China.

In Russia, 30% of the college students are in engineering, compared to 8% here. Another 30% or more take degrees in natural sciences. Moreover, unlike ourselves, the Russians are

ploughing back a large proportion of their science graduates into teaching, which implies a rapid buildup in the future.

Quality As Well As Quantity

It would be foolhardy to assume that these new Russian graduates are inferior to ours in the quality of their technical training. They start out with much more intensive mathematical and scientific preparation at the high school level. They study harder and longer in college, with more laboratory work and more practical training. Their courses and textbooks seem to be as thorough as ours. Even though the Russian graduates may be overspecialized, they get results.

These results have been striking. The Russians developed both A-bombs and H-bombs faster than we expected, and it's not certain that they had to rely much on espionage. They pushed ahead of us for a while in jet fighter design, and they showed up with a fleet of long-range bombers well ahead of schedule. They are crowding us on nuclear power, electronics and automation. There are grave fears that they have established a lead in the vital field of military rockets.

The goal of Soviet scientific manpower policy includes not only weapon supremacy but also leadership of the neutral and uncommitted areas of Asia, Africa and the Middle East. The Soviet leaders may be bluffing in their offers to export capital, but they are preparing to export Russian scientific and technical know-how in a big way.

How They Do It

The Russians are determined to win the race for scientific supremacy, and they do not count the cost. **They pay their scientists and engineers salaries that seem fantastic when compared with other Soviet incomes.**

Senior professors, research scientists and top engineers are a major segment of the Russian elite. Their incomes are frequently six to ten times the average industrial wage. (In the U. S. six to ten times the average industrial wage would be $25,000 to $40,000 a year.) Housing and other privileges are correspondingly lavish. While preaching equality, the Soviets use capitalistic incentives far more boldly than we do. Indeed, practicing engineers and scientists have been complaining about the exalted status of professors and top research people, and salary scales are now being adjusted to give greater emphasis to practical results.

The Russians are also generous in their aids to education. Tuition has just been made free at all levels. Undergraduates receive 200 to 500 rubles a month and graduate students 800 rubles (about equal to an industrial wage) to cover living expenses. The biggest stipends go to science and engineering students. College students are deferred from military service, and engineers and scientists often enjoy continued deferment even after graduation.

Finally, the Soviet leaders can channel engineers and scientists — and all other human and material resources — into any area they choose. And the areas the Soviet leaders choose are predominantly those that contribute to military or political objectives, rather than to a better life for consumers.

What's Our Answer?

We are certainly not going to adopt Soviet methods. We do not want scientific robots, but free men, able to understand and add to our democratic heritage. At the same time, our world leadership in technology — and perhaps even our survival as a nation — will be threatened if we allow ourselves to lag far behind Russia in the training of scientists and engineers. Ways to keep the United States in the race will be discussed in a later editorial in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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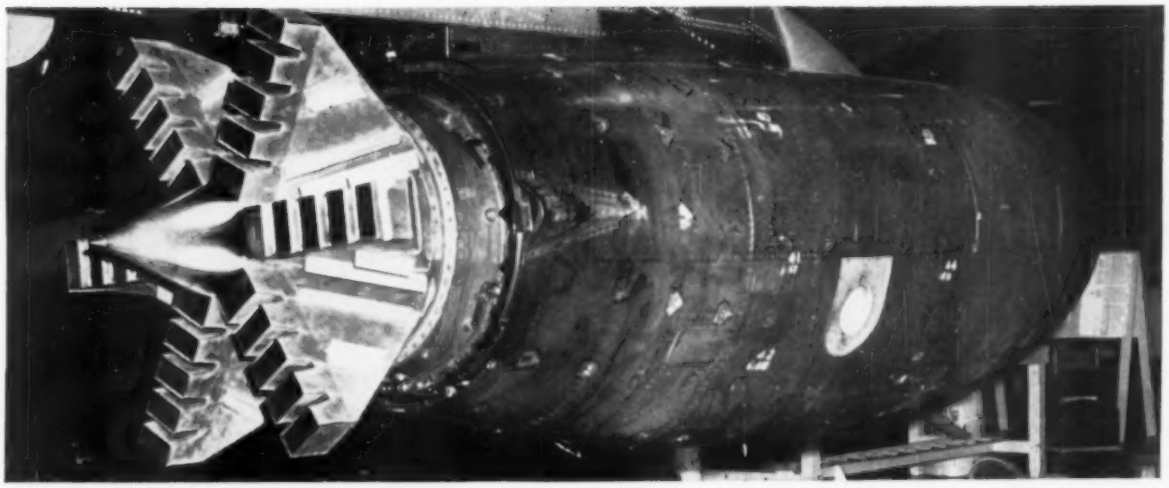

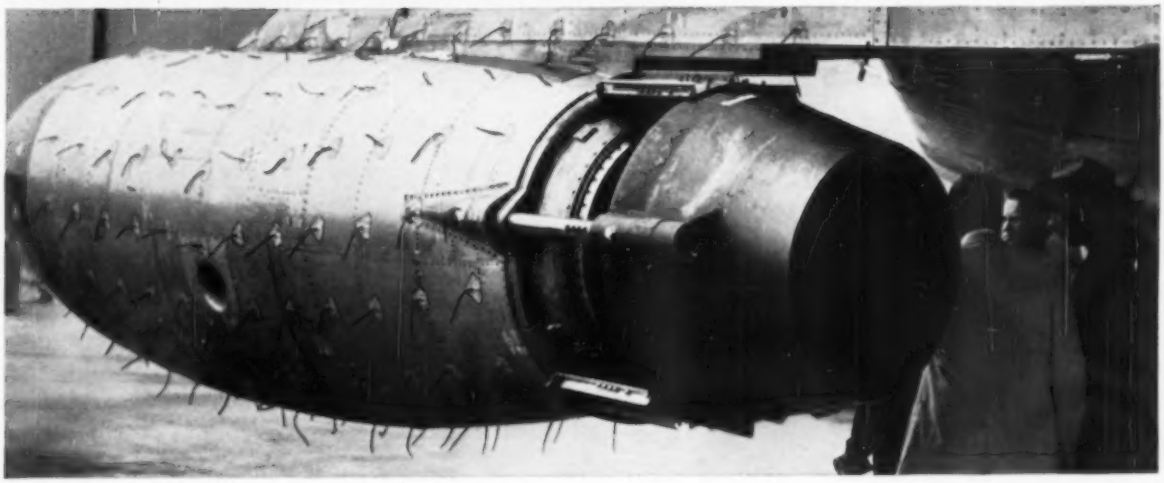

Boeing engineers meet two pressing jet-age problems

Many different kinds of Boeing engineers have worked together to develop the prototype sound suppressor (top) and thrust reverser (bottom), shown installed on the Boeing 707. On production 707 jet airliners, however, the two will be combined into a single unit capable of performing the duties of both the suppressor and reverser. Test results have been so satisfactory that Boeing has contracted to deliver 707s to airlines, beginning in late 1958, equipped with sound suppressor-thrust reversers.

This is an example of the many important contributions Boeing engineers—mechanical, civil, electrical and aeronautical, as well as specialists in physics, mathematics, acoustics and other fields—are making toward the progress of jet-age aviation.

Their work is challenging and creative, at the very frontiers of engineering knowledge, on the B-52 jet bomber, the KC-135 tanker-transport, the 707, the BOMARC IM-99 weapons system, and on aircraft of the future. Boeing is an "engineers' company," with more than 6,000 technical graduates employed.

Boeing now employs more than twice as many engineers as at the peak of World War II. But, because of steady expansion, more topnotch technical men are needed. They will work with superb facilities, including the multi-million-dollar new Boeing Flight Test Center, the latest electronic data reduction equipment, and a new wind tunnel, which will be in operation shortly, capable of velocities up to Mach 4.

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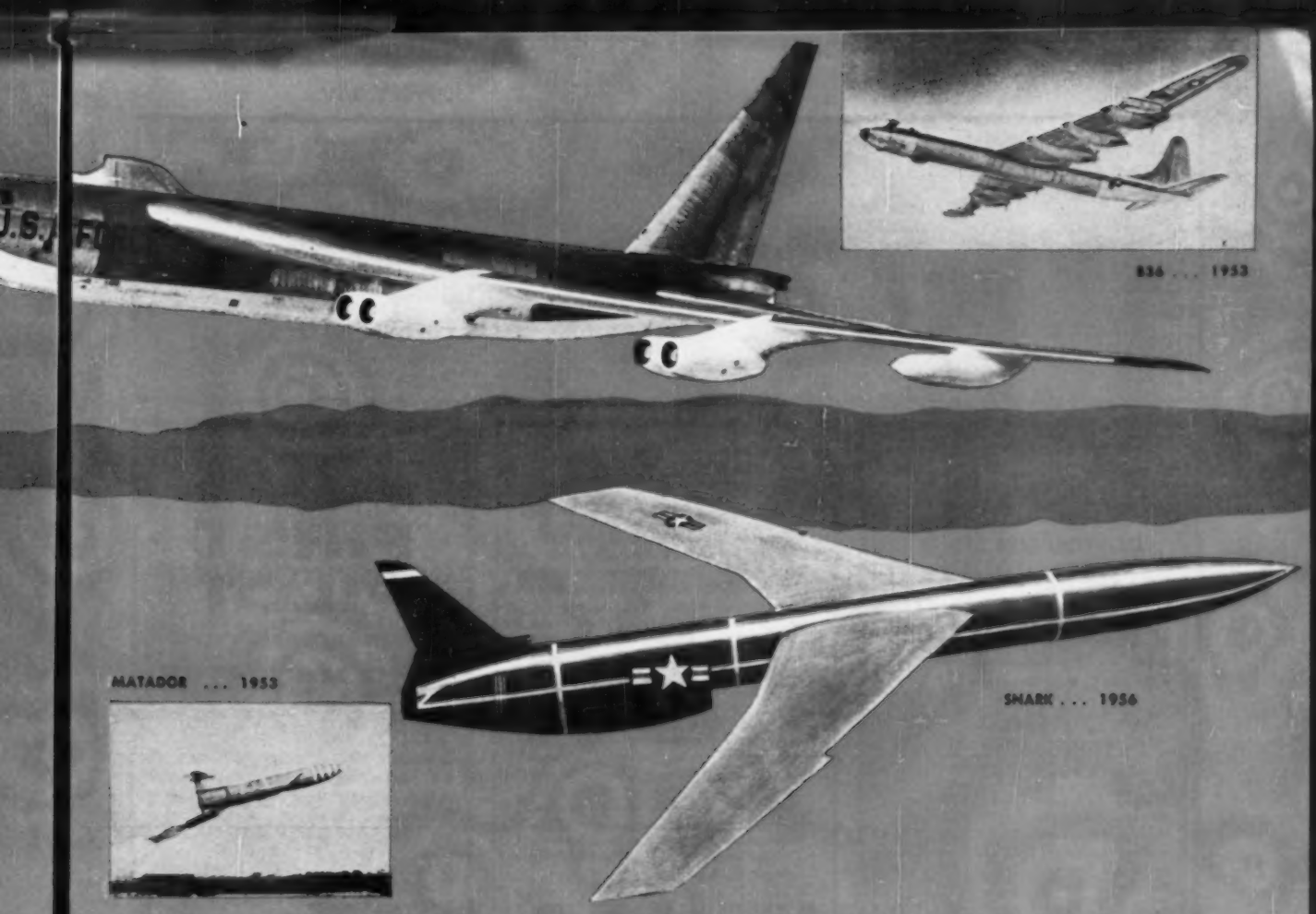

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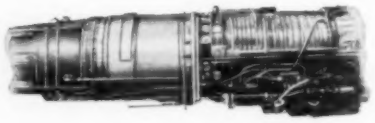

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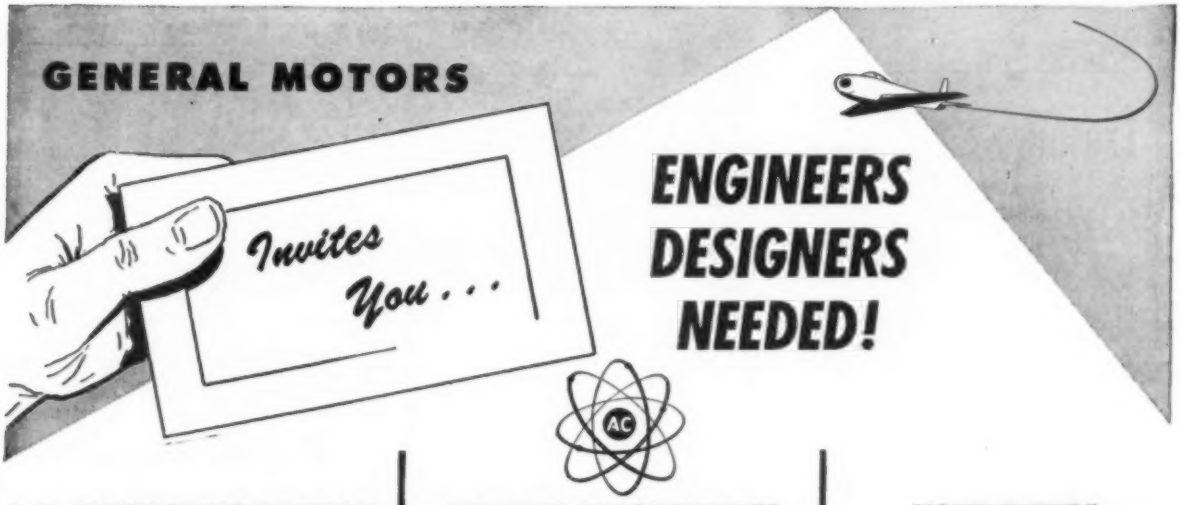
Pilot 7,500 hrs. ATR. Extensive DC-3, DC-4 capt. time. Age 34 married. Desire corp. or sales flying position. Admin. experience. avail. July. PW-1811 Aviation Week.

An employment advertisement in this EMPLOYMENT OPPORTUNITIES section will help you find the engineers you need. It's an inexpensive, time saving method of selecting competent personnel for every engineering job in the Aviation field.



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offers challenging, pioneering opportunities to ambitious men. We extend a cordial invitation to every deserving Engineer and Designer to write us their wants. We may be able to supply the square hole for the square peg!

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in the following fields: Missile Guidance Systems; Jet and Turbo Prop Engine Controls; Bombing and Navigational Computer Systems; Airborne Fire Control; U.H.F. Communications, etc.

YOUR FUTURE
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MILWAUKEE 2, WISCONSIN FLINT 2, MICHIGAN

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We Buy DC-3 and C-47
—also components, fuselages, center sections. Prefer runout or needing work, airline, passenger, or cargo. Pratt & Whitney or Wright. State price, time, quantity, type engines.
We are not brokers
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Lambert Field St. Louis, Mo.

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Need 50 Bonanzas, Navions, 180's, 170's, 170's, Aero Commanders, Twin Navions, Twin Beeches, etc.
Will Buy Dealers' Stocks New or Used
Vest Aircraft Co.'s Skyranch
BOX 5306, DENVER 17, COLORADO

WANTED
WRIGHT POWERED LODESTAR
By Corporation
Please Give Full Particulars
W-1844, Aviation Week
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Surplus or used aircraft sparkplugs wanted. Highest prices paid for R.B. 19R, 48S2, 5/2, 5/3, 5/4, 5/5, 23R, 27-R, 23, 21252, 31252; R.P. 43S; LE 44, 45; L.S. 48; A.C. 181, 281; R.S. 19-2R, 14-1R; R.C. 9R; R2-14-R; R-214; R.N. 5/3; 59052, 61382 638*, 648.
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(1350 H.P.)
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NEW OR FERRY TIME ONLY
GUARANTEED FREE OF RUST OR CORROSION
WILL SELL AS IS OR CERTIFIED TO YOUR SPECIFICATIONS
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P. O. BOX 233
MIAMI 48, FLORIDA

E-18S

Executive Beechcraft

NEW—

Manufactured: 1955 Actual certified flight hours: 19:00

[Repeat: nineteen (19) hours]

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Aircraft being offered for immediate delivery at a substantial savings below the original list price.

We own the aircraft offered.

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2500

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12B & 30" Pratt & Whitney Profilers
Kane & Roach Forming Rolls (6 stands)
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25" x 48" cc Monarch w/air tracer, 25 Hp
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Average Age of These Units—1945

Terms available on RENTAL or TIME up to 10 YEARS!

Tell us what you need . . .
Inquiries Invited

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A Trimotored Cargo-Northrop

A revolutionary and fantastic 20 ton aircraft with Cub performance in and out of pastures and improvised landing strips with 3 engine safety factor. Depending on load and wind, takeoff distance 250' to 1850'; landing 450' to 650'; climb 700' to 1350' per min.; cruise 165 mph; top 201 mph; stall 69 mph; range 1800 mi.; empty weight 25,000 lbs.; gross 40,000 lbs. with Wright 1820-99 1200 H.P. engines. With 1820-56A engines gross increases to 43,000 lbs.
Built by Northrop in 1950 for Arctic Rescue and Assault Transport to replace gliders but with ability to take off in short distances.
Rear loading power operated drive-in ramp for trucks, bulldozers, etc. Passenger conversion 30-40 passengers. Provisions for dual wheels for plowed field takeoff and landing, also fittings for skis. Landing gear fixed for low maintenance. Engine change 45 min. max. Designed for minimum of maintenance & operation cost and rugged construction.
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1954 "E" 35 with 225 HP engine. Full panel, Lear Transmitter & Receiver, Automatic prop control, air conditioner and 10 gallon auxiliary fuel tank. Blue and white. Very clean.

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1951 model. Full panel, Lear ADF, Narco Omnigator, 27 channel Narco Simplexer transceiver, cross wind gear and Stewart Warner heater. Extra-ordinary paint job. Engine and prop recently overhauled. Formerly corporation owned.

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Telephone K-4991

BEECHCRAFT D 18 S

N600D, Serial #76, 5500 Total time. Engine and props 511 SOH. Airframe disassembled and overhauled at 4200 hours. 2 spare engines 0 time since Spartan overhaul. C4A Gyrosyn compass, (1) ARN 7 ADF, low freq. receiver, ARC 15 omni, Collins 51R3 omni, Collins 17L3 transmitter, ARC T21 transmitter, three light marker beacon, localizer and glide-path receivers, edge lighted center overhead panel, speakers, custom instrument panel, complete de-icing, prop and windshield alcohol, boots new 54, windshield wipers, rotating light, electric step, oxygen, dual electric fire bottles, exhaust collector rings and tail pipes new last engine change. Hydramatics. 4 chairs in cabin, buffet with ice box, hot cup and 2 stainless thermos bottles, extra soundproofing. Ship has had excellent maintenance and has been hangared in heated hangar.

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Hiller—Model UH-12B, Very low airframe and engine time.

Perfect Condition.

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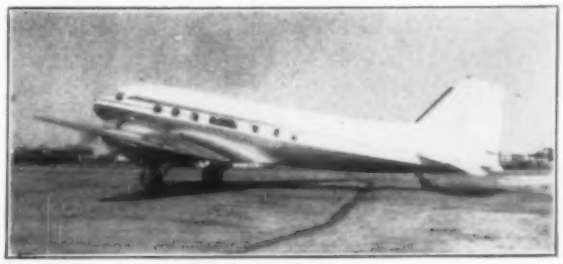

Custom 18 *Modernize your Model 18*

Make your travels pleasant and refreshing, as you relax in a roomier, more convenient cockpit, or spread out luxuriously in comfortable, adjustable reclining chairs in the spacious new modern interior. Plenty of big windows for easy vision, and an ingeniously fitted snack bar for in flight meals or tidbits.

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Fewer cancellations and detours, with shorter, smoother flight paths, and less crew and passenger fatigue. Simpler, lighter, cheaper, safer than pressurization. Now you can follow lower, easier operating altitudes by going around or between storms instead of over or through them.

CORRECT RADOMES FOR X or C BAND

• Only R/W has the reinforced double-shell dielectric radome recommended for X-Band—high transmission efficiency and high structural strength with no compromise or loss—no restrictions of air speed of any kind. Weather-tight fitting, leakproof, quiet. Won't vibrate loose. Lowest installation cost. • Separately hinged radome and scanner, for easy disconnect and adjusting —necessary for accurate antenna tuning. Quick access to instrument panel.

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with your choice of engines. Bendix or Collins radio complete disassembly with 8000 hour overhaul, new ship guarantee, custom interior, big cabin and picture windows, 200 mph.

C47s 8000 hours overhaul, NTSO engines, new ship guarantee. With or without conversion.

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Faster Cruise—Better Single Engine

Quieter Cabin—Quicker Takeoff

Smallest, lightest, simplest. No change in present hydraulics, oil cooler airflow, firewall, gear, or DC3 reliability, and no icing problems. Smooth operation on minimum power, with no load on hydraulic system, fast retraction.

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Manufactured 1942
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2 New Engines in Crates
1300:00 Total Time
Control Surfaces Recovered
All Bulletins Completed
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No Corrosion
As Is $18,995.00
Or Will Convert To Super

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Rochester Airport — Rochester, N. Y.
Call—Genesee 7301—LD-139

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Low Time—just out of major overhaul—close. United States Overseas Airlines, Inc., Cape May County Airport, Post Office Box 234, Wildwood, New Jersey

Sperry Zero Reader—Available June 15th—Used about 750 hours. Complete with altitude controller, go around button and all components. Fraction of original cost.
Wright R1820-205A—Zero time. All bulletins. Surplus to our needs. Make a modest offer. Would consider trades or credit against DME on either item.

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Telephone 7161

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LOGS AVAILABLE

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3-Place - Dual Controls
New interiors
Both skid & float gear
Long range tank
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TT 630:00 540:00
One with 3 hrs. SOH
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Spare parts for one year's operation.

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AERONAUTICAL SALES, INC.
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LOCKHEED in GEORGIA MOVES AHEAD AGAIN!

Staff of 500 Seen For A-Plane Plant

W. R. Rhoads to Head Dawsonville Project, To Be Biggest of Its Type in Nation

Lockheed Aircraft Corp., wasting no time in the development of nuclear aircraft testing facilities at Dawsonville, announced Tuesday that W. R. Rhoads will head up the Dawsonville project.

Mr. Rhoads, who lives at 120 Osner Dr., NE, is chief staff engineer at Lockheed's Marietta plant now. He has been with Lockheed since 1941.

He will direct the work of the approximately 500 scientists, engineers and service personnel who will be employed at the Dawsonville site.

LOCKHEED AND the Air Force officially announced Monday night at a dinner at Gainesville that they intend to build a 10,000-acre, multi-million-dollar nuclear aircraft test site just southwest of Dawsonville (population, 350).

And, perhaps as significantly, Lockheed's top Georgia executive hinted that the actual manufacture of a nuclear-powered plane—perhaps the world's first—might take place at Lockheed's Marietta plant.

AND

there's more that can't be published—yet

The world's largest integrated aircraft plant, at Marietta, Georgia, — where we build Lockheed C-130 Turbo-Prop Cargo planes and B-47 Jet Bombers—welcomes this new Lockheed program in Georgia.

Here are projects to challenge the very limits of imagination, vision, ability and capabilities of man!

This new atomic development and its effect on the adjacent manufacturing plant and new Engineering facility at Marietta, creates far reaching additional opportunities for Engineers and Scientists in a wide range of categories in both places.

Here is a program that is literally long range in both scope and product.

Qualified Engineers and Scientists interested in becoming associated with this progressive and rapidly expanding organization are invited to inquire for further information or personal interview.

Write to

ENGINEERING PROFESSIONAL PLACEMENT

LOCKHEED

AIRCRAFT CORPORATION—DEPT. AVW-64
761 Peachtree St., N.E., Atlanta, Georgia

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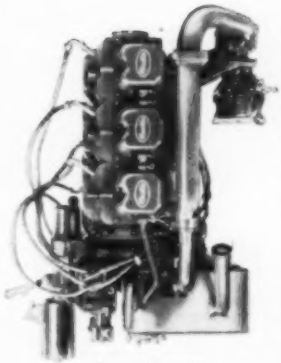
This is the name you see on 75% of all the helicopters flying today



There is no substitute for experience — and Franklin has more of it! Every year since 1939, far more Franklin engines have been chosen for helicopter power than any other kind in their power range. Industry figures show that 4 out of 5 helicopters under 400 h.p. built in 1955 had power by Franklin. Why this preference? Because no other engine can match Franklin's record for reliability with low operational and maintenance cost. Specify Franklin power in your next helicopter under 400 h.p.

WE ARE ALSO MAJOR SUBCONTRACTORS OF PRECISION MACHINING

We can now accept additional subcontract work similar to that long produced for major companies in the aircraft field. We are fully equipped for quantity production of precision machining and subassemblies of highest quality. Your inquiries are invited.

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Franklin POWER

THE STORY BEHIND THE STORY

LETTERS

Missile Mess

Want to mention with approval the AW editorial policy and over-all presentation.

A few comments on the so-called missile mess might be pertinent. Now that the automobile production man has conceded that "he" has been out produced by the Bison builders a re-examination might be in order.

Essentially, the people would like a shiny, new ICBM. It need not be trimmed in chrome or two-toned in pastel shades. But they want it soon; preferably a 1957 model.

They realize that an ICBM, either singly or in quantity, is not the only aerial weapon, but somehow they have grasped the apparently elusive fact that the nation first possessing a workable model has a distinct psychological, as well as military, bargaining factor. Therefore, if it be conceded that the USSR is producing large jet bombers at a faster rate than the U. S., then the people realize that the balance of power has shifted somewhat and the air-power stalemate is perhaps not "stalemated" anymore. It follows that an alternative course is necessary. Further, they would prefer that the ICBM not be bogged down in bureaucratic red tape or impeded by interservice rivalry; in fact, they would prefer to see the prototype not covered with the usual muslin. After all, the Soviet or Hottentot missile scientists couldn't care less about the outward appearance of the embryonic U. S. ICBM, "military security" or the U. S. Senator who speaks of our stockpile of intercontinental missiles notwithstanding.

It should be granted and obvious to some that the ICBM predecessors have been deficient in range and accuracy. However, its advantage over the jet bomber are significant in rate and time of travel to the target. Thus, when the ICBM reaches a workable, operating state in quantity the jet bomber is "dead" and crews will, in general, be glad to vacate the beasts. Additionally, the people realize that an ICBM can be produced for about one-eighth the cost of a B-52 type aircraft, excluding crew members who are usually written off at $50,000 apiece for accounting purposes.

It should also be realized that the Allies in World War II essentially overpowered Germany from the air standpoint, primarily because of the quantity of aircraft which gave greater firepower, bombpower, or whatever descriptive verbiage might be applied. If it isn't, it should be common knowledge that German missile and aircraft developments were way ahead of the Allies; after all, Germany had jet fighters in operational status and jet bombers in prototype, the V-1, V-2, etc. One doesn't have to be a Germanophile to grasp this. Although they arrived too late in the whole picture the psychological and military effect of the inadequate V-2 must be considered since none of them were stopped by any Allied defensive efforts.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

The need for an ICBM "crash" program is almost obvious enough to preclude mentioning: it would cost less than the Manhattan project, but must be faster because the presence of higher bomber production rates by another nation was not present at that period. This, regardless of whether one is in complete agreement with Trevor Gardener.

That each nation knows each other's prime target locations should also be obvious.

In the overall view recent trends seem to show the automobile industry in greater need of administrative assistance than the military aviation industry; or perhaps, in view of apparent relative jet bomber production Defense Secretary Wilson might concede to write a series of articles for AVIATION WEEK on the subject, "How to Stalemate a Stalemate," (with apologies to grammarians).

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Engineering Waste

I do not believe there is a great demand for engineers at this time. There are requirements for certain specialists, but any engineer to approach these fields even though he has a well rounded background must take a backward step in salary. Ask any engineer in the field for the past ten years, and he will tell you of the large amount of engineering manpower waste.

These things that are suggested will never basically correct the present problem. They will only help to lower the status of the professional engineer by allowing non-professionals to enter the field. Industry will be happy because they can obtain cheap engineering help. Youngsters will not enter the field because as you stated they can obtain the same heights without the investment in college. There are many examples of this today in industry because of the last emergency.

DONALD J. ABEL
Bridgeport, Conn.

Engineer's Wife

As the wife of a young engineer, I feel I must both agree and disagree with Mrs. Name Withheld (AW April 30, p. 118).

I must agree that many inequities do exist concerning the matter of experience and salary of engineers, even down to the 5-year level. Many good men are underpaid.

I want to *heartily* agree that engineers should be given a more professional standing, and suggest this could be done by limiting the title to those who have earned and deserve it. Today even a janitor is called a "steam plant engineer".

However, there my agreement ends. I have three sons. Inequities, poor professional standing and relatively poor pay notwithstanding, I hope they *all three* consider being engineers. I'd like to see them in rocket work, like their father, or in aircraft, guided missiles, or allied industries. These engineers have the future in their pocket!

My husband started in engineering at $242 a month. Today he has nearly tripled his salary and is employed by one of the finest aircraft companies.

He is not a "pure scientist" but his work is so exciting and satisfying to him, I am sure he'd be the last person to discourage our sons from studying engineering.

This may be high-sounding, but money isn't everything, with the future in your pocket.

When I watch films of rocket launchings, I'm only sorry I'm not an engineer myself.

MRS. IDA REITER
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Bitter Engineer

Engineering shortage? Bah! I am writing in order to give vent to my frustration and to enlighten young engineering graduates as to the ultimate goal to which they can aspire in the engineering profession. I am sure that many other engineers have had my experience.

At the very old age of 35, I am ready to be retired. Armed with a B.S.M.E. degree from a reputable university, and 15 years of intensive and progressive design development experience in aircraft, rocket engines, guided missile systems, including administrative and supervisory responsibilities, the frightening reality is that "I Am Expendable!"

When the last firm I was with decided to relocate, I was unable to make the move due to personal obligations and family considerations.

Every application that I made for a new job proved unsuccessful, for I had either too much experience, my background just didn't fit the specific requirements, or there were no openings at my particular level, etc. All added up to the same thing: What does one do at 35 in the prime of life, with children to provide for? Wait for a commensurate job offer?

With a small amount of savings and the help of my wife, I am going to establish a small retail clothing business. This is what happens to high powered engineers in the United States. Why all the wonder that the Russians are overtaking us in technological development? NAME WITHHELD

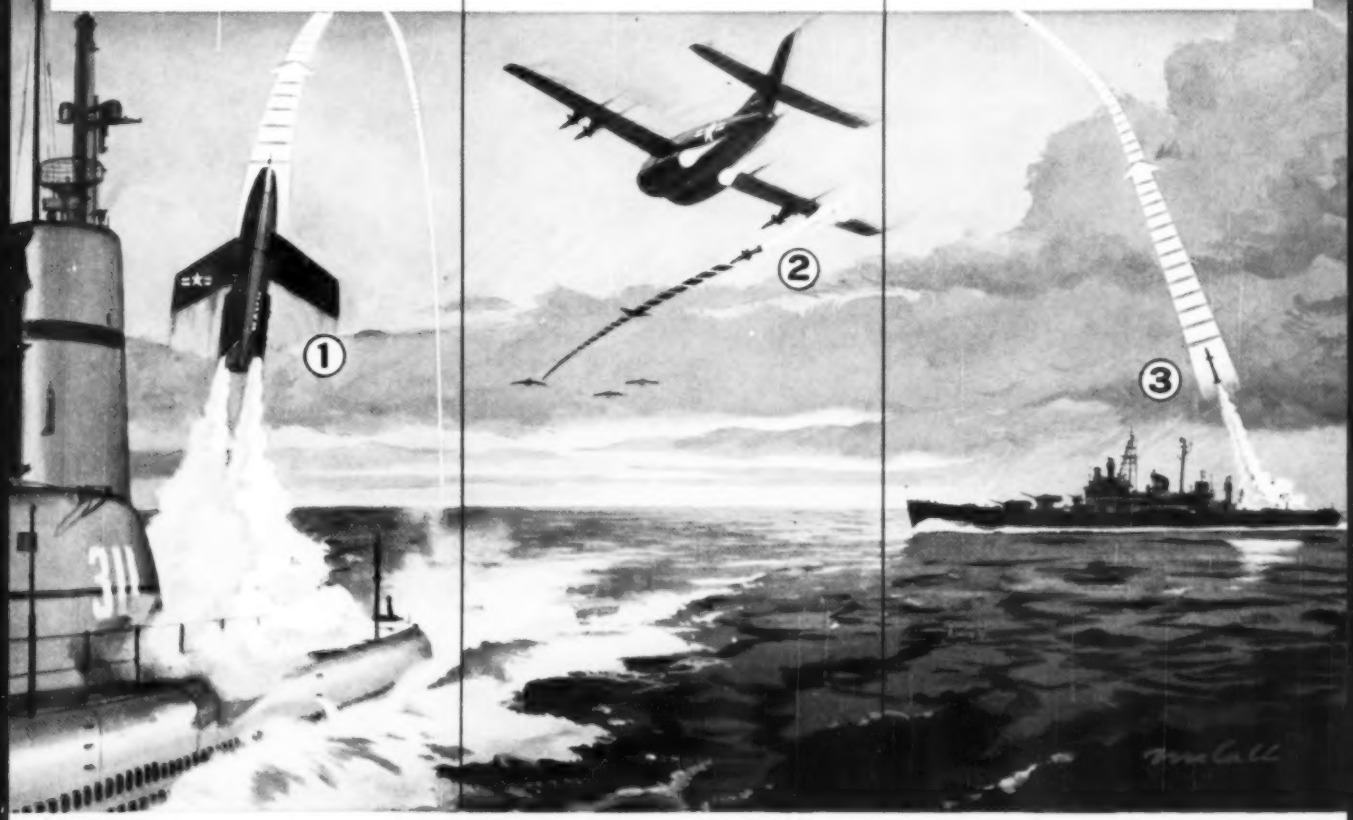
P. S. I am available for engineering consulting work in guided missile hydraulic powered flight controls, i.e., between dress sales.

THE STORY BEHIND THE STORY

1. SURFACE-TO-SURFACE missile—Chance Vought's Regulus—can be launched from ship or submarine to destroy distant shore target. A Sperry stabilization system provides the electronic brain which holds Regulus on its course with a vise-like grip.

2. AIR-TO-AIR missile—Sperry Sparrow I—gives carrier-based interceptors deadly weapon against enemy jets. Developed by Sperry for the Bureau of Aeronautics, Sparrow I, a rocket-powered, supersonic weapon, is in production for fleet use.

3. SURFACE-TO-AIR missile—Convair's Terrier—travels a precise radar beam to destroy enemy aircraft. Produced for the Bureau of Ordnance, Sperry designed and built radars are used to control Terrier's flight and to make possible the deadly accuracy of this missile.



NEW NAVY MIGHT EMPLOYS MISSILES OF ALL TYPES

The U. S. Navy has come a long way from the world's first missile, shown at right, to the missiles employed in the fleet today. Our modern Navy, with its modern weapons, has new tactical power to strengthen our nation's defenses. Sperry, too, has come a long way since its pioneering work in gyroscopics and missiles. Today Sperry is putting its many capabilities to work in seven major missile systems—of all types—ranging from complete systems' cognizance to major sub-system responsibility.

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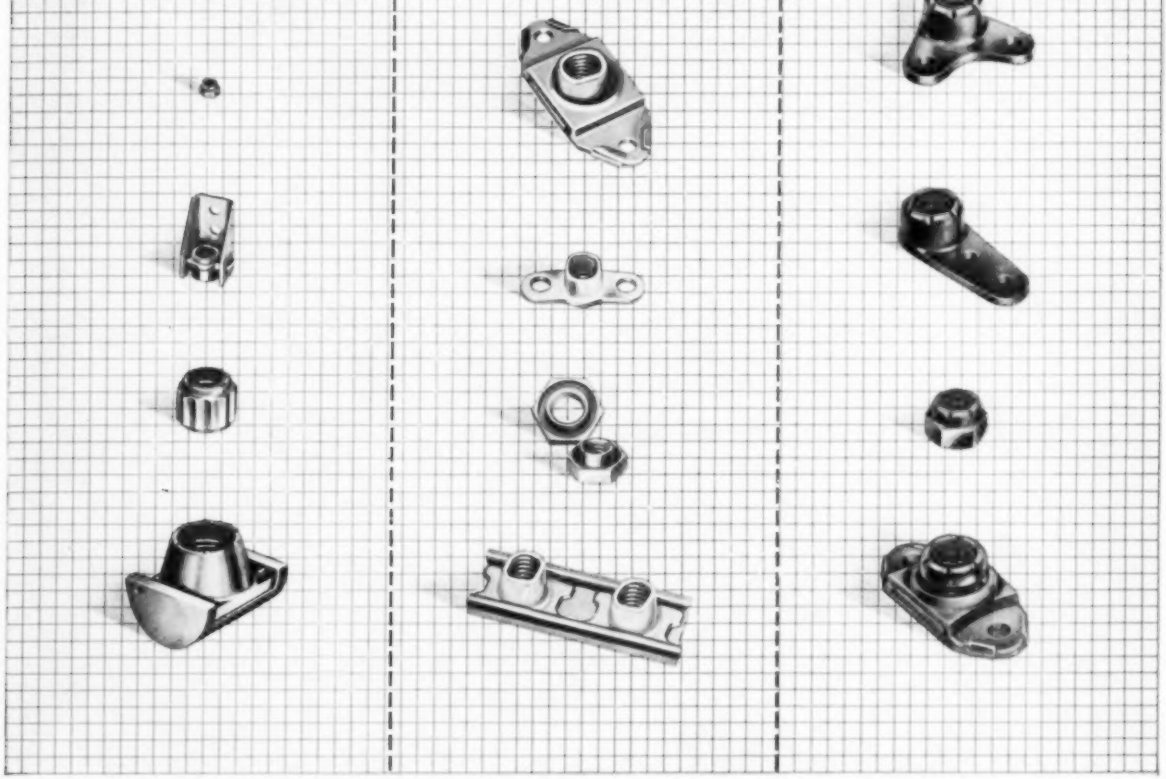

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